The Journal

OF THE

Ministry of Agriculture

VOL. XXVIII.

April, 1921, to March, 1922.

LONDON
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
AND PUBLISHED BY THE MINISTRY OF AGRICULTURE AND FISHERIES
WHITEHALL PLACE, LONDON S.W.1

SUPPLEMENTS TO THE JOURNAL OF THE MINISTRY OF AGRICULTURE.

* Out of print.

INDEX TO VOL. XXVIII.

APRIL, 1921, TO MARCH, 1922.

NOTE.—References to Insects, &c., and Fungi are indexed under the headings "Insects, &c.," and "Fungi" only, to Weeds under the heading "Weeds" only, to Fruit under the heading "Fruit" only, and to Diseases of Animals under "Diseases of Animals" only.

Articles or reports on the following subjects have appeared in the *Journal* each month or from time to time, and are not separately indexed :—Notes on Feeding Stuffs, Notes on Manures, Notes on Agriculture Abroad, Outbreaks under the Diseases of Animals Acts, Lists of Additions to the Ministry's Library, and Selected Contents of Periodicals.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

THE JOURNAL

OF THE

MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 1.

APRIL, 1921.

NOTES FOR THE MONTH.

Second Meeting of the Council of Agriculture for England.

THE second meeting of the Council of Agriculture for England was held at Essex Hall, London, on March 4th, when the Earl of Selborne, K.G., G.C.M.G., was elected chairman for the year. During the course of the proceedings the Minister of Agriculture, Lieut.-Col. Sir Arthur Griffith-Boscawen, addressed the Council.

Among the resolutions moved was one in favour of maintaining the existing restrictions upon the importation of live animals from abroad, in order "to ensure the due protection of British livestock against the ravages of serious contagious disease." An amendment to add. as an additional reason for the continuance of the embargo, the words "and to encourage the maintenance of the milk supply of the country" was carried; while an amendment to make an exception in the case of Canada was defeated. Another amendment proposed to refer the whole question of the embargo to a Committee of the Council for enquiry and report. This was defeated, as also was one for a joint inquiry by the Ministry of Agriculture and the Ministry of Health. The original resolution, with the addition agreed to, was then carried by 71 votes against 15. It read as follows:—

> "That to ensure the due protection of British Livestock against the ravages of serious contagious disease, and to encourage the maintenance of the milk supply of the country, this Council of Agriculture for England most earnestly requests His Majesty's Government to maintain the existing restrictions upon the importation of live animals from abroad, without attempting to discriminate between one importing country and another."

(86447) P6/198. 11,250. 3/21. M. & S. A

The Council accepted an invitation to send representatives to the National Conference, summoned by the Lord Mayor of London, at the Guildhall on March 9th, to consider the question of the embargo on Canadian store cattle, and Mr. Langford, Mr. Strutt and Mr. Rea were chosen to attend.

A resolution was moved in favour of the compulsory registration, by County Agricultural Committees, of all bulls kept for service—except pedigree bulls used solely in the owners' herds—if and when certified suitable for breeding purposes. At the request of the chairman, a brief statement on this subject was made by Sir Daniel Hall, Chief Scientific Adviser to the Ministry. After explaining the difficulties of implementing the resolution, he suggested that the matter be referred to the Livestock Committee of the Ministry. This was agreed to, and the resolution was withdrawn.

The Summer Time Act was the subject of a resolution which recommended that "in the interest of the agricultural industry the proposed Summer Time Act for 1921 should operate from May 1st till September 3rd." An amendment in favour of abolishing "Summer Time" was carried, and by 39 votes to 18 the following resolution was adopted:—

"This Council recommends that, in the interests of the agricultural industry, summer time be abolished."

The provision of telephone call offices in rural areas was then discussed, and after Mr. F. L. C. Floud, C.B., Permanent Secretary to the Ministry, had read a statement on the subject which had been received from the General Post Office, a resolution in the following terms was carried *nem con*:—

"That in view of the proposed heavy increase in charges for telephones, and the failure of the 'Party Line' system, the Government be requested to make all telegraph offices in rural areas public telephone call offices as well."

A resolution in favour of amending the Agriculture Act in relation to the method of fixing payments arising out of the guaranteed prices for wheat and oats was moved in the following terms:—

"That, in the opinion of this Council, the statutory provision whereby payments arising out of the guaranteed prices for wheat and oats under the Agriculture Act are based on an average yield for the whole country, is unfair to the more productive and highly rented areas; and that a separate average yield for each county should be adopted, such average yields to be determined by the Minister on the

recommendations of the Agricultural Committee for each administrative county, and that the Act be amended accordingly."

On being put to the meeting it was defeated. The following resolution in favour of re-introducing the payment of rewards for the destruction of rats was also defeated:—

"That the Ministry of Agriculture and Fisheries be asked to press for the amendment of the Rats and Mice (Destruction) Act, 1919, in such a manner as to allow of rewards for the destruction of rats being paid from the County Fund."

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The Supply of Store Cattle.

IN the recent controversy on the question of store cattle in the United Kingdom, certain important facts have been overlooked. For example, few people appear to realise that the decline revealed by the Agricultural Returns collected on the 4th June, 1920, was confined almost entirely to the herds of England and Wales. The decrease in Scotland, if compared with that of England and Wales, is seen to be very small, while in Ireland, whence Great Britain derives a large part of the total number of stores required for feeding, there was practically no change; indeed, the total number of cattle in Ireland last year was very little short of the highest number recorded. It follows that there was in Ireland a heavy surplus of store cattle, from which the decline in Great Britain could be made up, and the number of fattening stores shipped from Ireland in the seven months June to December, 1920, was, in fact, 281,000, as against an average of 163,000 in the corresponding period of 1917, 1918 and 1919.

It will be remembered that in January last there was an outbreak of Foot-and-Mouth Disease in Ireland, and it became necessary to place an embargo on importation into Great Britain, with the result that the number of Irish stores received in the first two months of this year in Great Britain has declined sensibly. It has now been possible to relax the restrictions, and there is no reason to doubt that Irish stores will appear again in large number in the English and Welsh markets. The considerable increase in the importation of Irish stores last year was reflected in the total number of store cattle returned as having been offered at those markets in England and Wales which are included in the Ministry's "Return of Market Prices." The figure for the period June 3rd to Decem-

ber 29th, 1920, was 372,000, which compares very favourably with the average of 281,000 in the corresponding period of the years 1917-1919. Since the beginning of the present year there has been a slight diminution, consequent upon the outbreak of disease already mentioned.

The decline in the total stock of cattle in England and Wales last year occurred under each of the three main heads, which are "dairy cattle," "other cattle" and "calves," but was most marked in the case of the last named. Since animals classed as calves in June last would now be described for the most part as yearlings, there may possibly be a moderate shortage of that class of store cattle this year. There is, however, ample evidence that calves are being kept or purchased for rearing in considerably larger numbers than in the same period in 1919 and 1920. The total of 4,368,000 head of dairy cattle in the United Kingdom recorded in 1920 was the lowest since 1913. In that year the number was 4,300,000, but during the next three years the total number of cattle in the United Kingdom increased by no less than half a million. With a larger dairy herd as breeding stock in 1920 and a keen demand for good class store cattle and calves there is no reason why the total stock of the country should not increase again as it did after 1913.

Employment in Agriculture: An Inquiry.

FOR some time past it has been suggested that employment on the farms in this country is decreasing. In order to ascertain the facts, members of the District Wages Committees in England and Wales have been invited by the Agricultural Wages Board to give information from personal knowledge of conditions in their respective districts, and to this end schedules of inquiry were sent out. The greater number of these schedules have been completed and returned and the contents may be summarised as follows:—

(a) That among men employed in connection with the care of animals, referred to as "Special classes," there is little unemployment.

(b) That among ordinary farm labourers unemployment is not much in excess of that which existed in January, 1920, and that it affects mostly the unskilled and inefficient workmen.

(c) That among boys unemployment to an unusual extent is not general although it is anticipated that the increase in

their minimum rates of wages coming into operation in March will cause more unemployment.

(*d*) That few women are regularly employed in agriculture, and only in some districts are any appreciable number unable to obtain work on the land.

Briefly put, unusual unemployment is to be found in the north of England (Cumberland, Westmorland, parts of Lancashire and Yorkshire); in the Midlands, Herefordshire and Warwickshire are affected; in the South, Hampshire and Wiltshire; in the Home Counties, Berkshire; in Wales, Anglesey, Carnarvon and Merioneth. It is agreed generally that farmers show a tendency to keep the minimum of workers necessary, and to suspend all work that may possibly prove unproductive. The grounds for their action are stated to be (*a*) the high wages for unskilled workmen; (*b*) difficulty in getting permits of exemption for inexperienced or inefficient workmen; (*c*) the shorter hours of labour; (*d*) the low yield of the 1920 harvest; (*e*) the general decline in prices of farm produce; and (*f*) high rates and taxes. The representatives of the workers contend that land is not being cultivated properly, and that if "good" cultivation were enforced there would be no unemployment. They find in the increasing use of modern machinery another contributory factor to present conditions.

It is satisfactory to learn that with few exceptions all ex-Service men formerly employed in agriculture have found re-employment on the land if they have so desired. At the same time cases are given of men who have passed to other industries owing to the higher wages prevailing.

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The International Institute of Agriculture at Rome.

FROM time to time the Press of this country publishes statements of the condition of cereal and other crops throughout the world, stating that these emanate from the Imperial Institute at Rome, but very few people are aware of the origin or constitution of this Institute, or of the important work that it carries through in the interests of international agriculture. The origin of the Institute dates back to 1905 when it was founded in accordance with the terms of the Convention signed by the representatives of some forty different states. Since the year of its foundation other Governments have signed the Convention, and to-day it may be said that the whole civilised world contributes to the only agricultural organisation of an official character established by a formal treaty between different states, managed and controlled by

representatives of those states and supported by their joint contributions.

As an international organisation of an official character the International Institute of Agriculture may indeed be said to have been the first of its kind in the world; it existed prior to the formation of the League of Nations, and indeed it has the universal support that the League has not yet obtained. The origin of the Institute is interesting. The late Mr. David Lubin of the United States realised that the farmers of the world could not combine to adjust their cultivation to world needs so long as they remained isolated and did not know what those needs were. He therefore proposed to the King of Italy the establishment of an International Institute to study the conditions of universal agriculture, publish returns, collect and disseminate information on economic and technical agricultural questions, and so facilitate production and aid agriculture throughout the world. The King not only took up the idea with great enthusiasm but helped to erect the magnificent building that houses the Institute in Rome, and transferred to it revenues worth £12,000 a year.

The chief object of the Institute is to prepare reliable reports of the estimated production of crops and available supplies throughout the world. and it was hoped that this information would prevent the cornering of crops on the one hand and violent fluctuation in price on the other. Bearing in mind the extent of international trade in foods and the essential unity of agricultural science the importance of the information that the Institute circulates will be understood. It is managed by a permanent Committee composed of representatives of the various signatory Governments resident in Rome. From time to time a General Assembly of delegates appointed by their Governments reviews the main principles of policy. Before the War this General Assembly met every two years, while the Permanent Committee meets at least once a month and several of its members devote themselves entirely to the Institute's work.

At present the International Institute of Agriculture is organised under three sections: (*a*) Statistics, (*b*) Agricultural Intelligence and Plant Diseases, and (*c*) Economic and Social Intelligence. Each issues a bulletin in several parts, as well as occasional leaflets and notices to the Press. The Institute also publishes an annual statistical review of the world's agriculture and an annual summary of agricultural legislation. Other publications also are issued from time to time. A meet-

ing of the General Assembly was held in November last and this was the first for seven years, the operations of the Institute having been curtailed by the War.

The Ministry of Agriculture's Exhibits during 1920: Proposals for 1921.

DURING the War it was impossible for the Ministry of Agriculture to be represented at Agricultural Shows, but last year the long suspended effort was resumed and an agricultural exhibit was staged at thirteen of the leading Agricultural Shows in England and Wales. Wherever the Ministry was able to secure adequate representation, the public response was very definite. Not only were farmers present in large numbers in search of information, but they took full advantage of the leaflets and other publications that were on offer.

In addition to a purely agricultural exhibit, the Ministry extended its interest to the horticultural side of food production, and was represented on forty-five occasions by an exhibit either at Horticultural Shows or in leading country markets. This new departure was designed in the first instance for the benefit of the smallholder, whose methods do not keep pace with his enthusiasms and whose opportunities for acquiring wider knowledge of sound method are few. This exhibit has now been enlarged and its scope broadened, and it is sufficiently comprehensive to provide a good deal of help and guidance, even for the advanced fruit grower. Among the subjects on which information is given through this medium are reliable fruit stocks, pollination and ' reversion " of black currants, the preservation, grading, packing and storage of fruit, the history of insect pests and fungoid diseases, and the value and methods of apiculture. In addition to the ordinary exhibit, a special one has been provided to show the results of investigations of Wart Disease as carried out at the Potato Testing Station at Ormskirk. Not only have specimens of diseased potatoes been on view, but there have been specimens of those immune varieties that may, when fully accepted by the industry, enable this country to show a clean bill of health. It is proposed during the season now about to open to provide an exhibit at thirty Agricultural, Fat Stock and Horticultural Shows.

MINIMUM PRICES OF WHEAT AND OATS OF THE 1921 CROP.

THE Ministry of Agriculture and Fisheries thinks it desirable to explain the procedure in regard to the minimum prices guaranteed by the Agriculture Act, 1920, in respect of wheat and oats produced in 1921. These minimum prices will not affect the marketing of wheat and oats. Every grower will be free to dispose of his wheat or oats in any manner he may desire, and at the best prices he can obtain.

Calculation of Minimum Prices.—The Act provides that the minimum prices for any year are to be such prices for a statutory quarter as correspond to the following minimum prices for 1919, which is to be taken as the standard year:—

Wheat	... 68s.	per customary quarter of	504 lb.
Oats	... 46s.	,, ,, ,,	336 lb.

The minimum prices for 1921 will be ascertained and certified by three Commissioners appointed in accordance with the provisions of the Agriculture Act. As soon as possible after the completion of the harvest, the Commissioners will ascertain the percentage by which the costs of production of the wheat and oats respectively of 1921 are greater or less than the costs of production of the wheat and oats of 1919

The minimum prices for 1919 set out above will then be increased or decreased by the same percentage as the cost of production in 1921 has increased or decreased, and the equivalents for a statutory quarter of the prices calculated in this way will be the minimum prices per statutory quarter of wheat (480 lb.) and oats (312 lb.) respectively for the year 1921. As soon as the minimum prices are certified by the Commissioners, they will be published by the Ministry of Agriculture and Fisheries.

Payment to Growers of Wheat and Oats.—No payments will be due to producers of wheat or oats unless the minimum price for wheat or oats as fixed by the Commissioners for 1921 is greater than the average price for wheat or oats for the seven months from 1st September, 1921, to 31st March, 1922, as calculated from the weekly returns made under the Corn Returns Act, 1882. These average prices will be published in the London Gazette as soon as possible after 31st March, 1922.

If the average price for wheat as so ascertained is less than the minimum price as fixed by the Commissioners, each

grower will be entitled to four times the difference for each acre on which wheat was produced, and if the average price for oats is less than the minimum price each grower will be entitled to five times the difference for each acre on which oats were produced.

It is to be observed that if the average prices for wheat or oats are greater than the minimum prices no payments will be due, even though an individual grower may have sold his wheat or oats at less than the minimum price. It is the average price over the whole country which decides whether any payment has to be made to the grower and not the actual price realised by him.

The amount payable to any individual grower will thus depend on the area on which he produced wheat or oats. The yield per acre which he obtained, or the price at which he sold his crop, will not affect the amount payable.

It will be seen that it will not be known until after the end of March, 1922, whether any payment and, if so, how much is due in respect of wheat or oats produced in 1921. Any payments then due will be made by the Ministry of Agriculture and Fisheries as soon as possible.

Claims.—No payment will be made unless a claim is made in respect of the area on which the wheat or oats have been produced. Forms of claim for 1921 will be issued along with the forms on which the Agricultural Returns have to be made on 4th June, 1921. The claims must be forwarded direct to the Ministry of Agriculture and Fisheries not later than the 30th June, unless the claimant can show that he became the occupier of the land after that date, in which case the Minister may accept a claim made not later than the 1st September, 1921.

The claimant will be required to enter on the form of claim particulars of each separate field of wheat or oats. The number of each field as shown on the 25-inch Ordnance Survey Map, and the ploughed area of wheat or oats in each field, will have to be stated. These detailed particulars are necessary to enable the Ministry and the County Agricultural Committee to verify the accuracy of the claim.

Copies of the Ordnance Survey Map on the 25-inch scale can be purchased through any bookseller, price 5s. per sheet. In most districts copies of the map of the district can be inspected at the office of the County Agricultural Committee. Information as to the number of fields can also be obtained

at the local office of the District Valuer of the Board of Inland Revenue. The Assistant Overseer may also possess a copy of the map of his parish. In case of difficulty, inquiry should be made of the Cultivation Officer of the County Agricultural Committee. Farmers are advised to take steps forthwith to ascertain the numbers of the fields sown or intended to be sown with wheat or oats as shown on the 25-inch Ordnance Survey Map.

Mixed Corn.—Where wheat or oats have been produced intermixed with another crop, the amount payable in respect of the area of wheat or oats will be adjusted in such manner as may appear proper, but the claimant will be required to state in his claim the quantity of each kind of seed sown per acre in the mixed crop.

Persons entitled to Claim.—The person to make a claim is the person who on the 1st September, 1921, is the occupier of the land on which the wheat or oats have been produced. Where, however, there has been a change in the occupation of the land and the outgoing tenant is under custom or otherwise entitled to harvest the wheat or oats, he will be the person entitled to claim.

Land Negligently Cultivated.—In any case where it appears that land in respect of which a claim is made has been negligently cultivated, the payment to which the claimant would otherwise be entitled may either be altogether withheld or may be reduced to such extent as may be thought proper to meet the circumstances of the case.

Penalties under the Act for False Statements.—The attention of farmers is drawn to the importance of filling up their claim forms accurately and carefully.

Section 3 (3) of the Corn Production Act, 1917, provides that:—

> If for the purpose of obtaining a payment under this part of the Act, either for himself or for any other person, any person makes any false statement or false representation, he shall be liable on summary conviction to imprisonment with or without hard labour for a term not exceeding six months, or to a fine not exceeding fifty pounds, unless he proves that he did not know and could not with reasonable diligence have ascertained that the statement or representation was false.

Amounts improperly obtained are recoverable by the Ministry.

RESEARCH IN ANIMAL BREEDING.

I.

R. C. PUNNETT, F.R.S.,
Professor of Genetics, University of Cambridge.

WHEN Mendel's discovery in heredity, made over 50 years ago, was unearthed in 1900, it was at once clear to a few scientific men that a new era in the breeding of animals and plants had commenced. What the breeder requires is "certainty" in so far as it is possible to attain it. When a given mating is made he wishes to know what is likely to result, and further, as he is generally of an intelligent and inquiring mind, why the result is obtained.

Through Mendel's work and its recent development the breeder is at last being placed in a sound position to answer these questions. Plant breeders have not been slow to take advantage of the new knowledge. Realizing early the immensely greater powers of control over the living thing conferred upon them by Mendel, they set to work to build up new strains of cereals and other valuable plants. It is unnecessary to detail here the remarkable success which has already attended their efforts, nor to forecast the enormous economic gain that must come to the world when the methods are applied to the produce of vast tropical areas. The rapidity with which plant breeding stations are springing up in both hemispheres is evidence of the service which Mendel rendered to mankind.

While, however, the plant breeder is now fairly embarked upon his career of conquest, the breeder of animals tends to lag behind. Nor is this difficult to understand. The majority of plants are self-fertilized. It is an easy matter to obtain the pure strains essential for purposes of Mendelian analysis, to keep them pure, and to purify any desirable new strain that may be built up. Animals with their bi-sexual mode of reproduction are far more complicated things to deal with, and as we shall see later, the separation of the sexes may in itself introduce complications peculiar to this mode of reproduction. Then again, plants are cheap owing to their great powers of multiplication. Thousands of wheat plants may be grown for the cost of a pig. This rapid multiplication of plants renders more easy the process of Mendelian analysis, and in consequence, man's power of control over them is enhanced.

It was proved years ago that Mendel's principles of heredity apply equally to animals and plants, and the importance of the subject led the Board of Agriculture some years ago to set aside a small grant from the Development Fund for research in animal breeding. The sum allotted, less than £200 per annum, only allowed of work being undertaken with small animals such as poultry and rabbits, but this in itself was no disadvantage, for the object of the work was not to improve the breeds of rabbits and poultry, but to acquire knowledge of the laws which underlie inheritance in animals generally. In this series of brief articles an attempt will be made to indicate the drift of these experiments, and their possible bearing upon economic problems. Before doing so, however, some account must be given of the nature of Mendel's discovery itself; this is the corner stone of our present knowledge, and unless it is clearly understood, later developments must prove unintelligible.

The essence of Mendel's discovery may best be made clear by a simple example, from cattle. The breeder knows, perhaps only too well, that red calves are apt to appear occasionally even in the most highly pedigreed breeds of Aberdeen Angus or Holstein. They are rarely welcomed, and in most cases the breeder would go to a great deal of trouble to ensure that they never appeared in his herd. He tries to get rid of the taint by vealing the red calves, but still they come from time to time. He may try to explain their appearance as a throw-back to some remote ancestor, and though this may ease his conscience it does not help to purify the herd. Mendelism enables the breeder to understand why these red calves appear, and provides the knowledge which can be used to prevent their ever appearing again.

Let us suppose a Mendelian analysis of this case to be made in the usual way. The first step is to cross the red with the black, and it will be found that the pure black bull crossed with red cows will produce black calves only (see Fig. 1). For this reason, black is said to be *dominant* to red, which is *recessive*. The next step is to mate together these first crosses, or F1* animals as they are termed. It will be found that their progeny, the F2 generation, consists of both blacks and reds, but not mixtures of the two colours, and if a sufficient number

* For the sake of clearness in experimental work the cross is taken as the point of departure. The first cross animals belong to the first filial = F1 generation. When F1 animals are mated together they produce the 2nd filial or F2 generation, F2 animals mated together give a 3rd filial or F3 generation, and so on. Similarly in the other direction the parents are labelled as the P1 generation, the grandparents as the P2 generation, and so on.

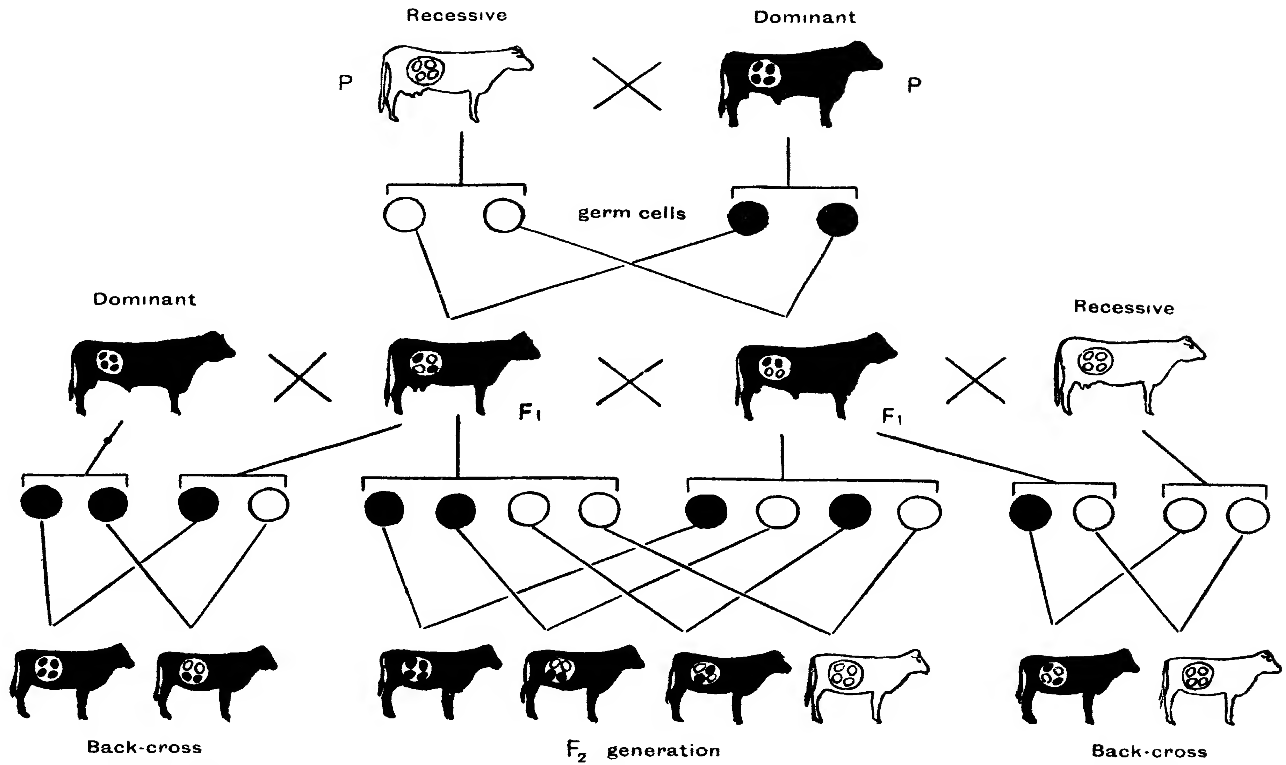

FIG. 1.—Illustrating simple Mendelian Inheritance in a Cross between Red (recessive) and Black (dominant) Cattle. The nature of the Germ Cells carried by each animal is indicated inside the circle on its body.

have been reared, it will be found that the blacks are about 3 times as numerous as the reds. To cover such facts Mendel devised a simple explanation in terms of germ cells. Red and black are alternative in heredity because they are alternative in the germ cells. A germ cell contains *either* that which causes the development of black pigment *or* something which causes the development of red pigment; but it is in the order of nature that it cannot contain both. It is not known at present what these contents are, but as their existence is recognised a name must be given to them, and they are usually spoken of as *factors*. A germ cell, in our cattle then, contains either the factor for black or the factor for red. When an animal breeds true to a given character it means that all its germ cells carry the factor for producing that character. All the germ cells of a true breeding black contain the factor for black, and all the germ cells of a true breeding red contain the factor for red.

Let us refer again to the diagram (Fig. 1). If a red cow is crossed with a black bull a " red " germ cell from the cow is being united with a " black " germ cell from the bull. The resultant animal will be black because black is completely dominant over red, but although it is black it is not a true breeding black. When such an animal reaches maturity it produces germ cells corresponding to the germ cells by which it was produced itself. In their formation the red and the black factors separate cleanly from one another, and in consequence half of its germ cells contain the black factor and the other half contain the red factor. The F1 animals, therefore, whether bulls or cows, produce " red " and " black " germ cells in equal numbers, but owing to the complete dominance of black, they are indistinguishable from true-breeding blacks in appearance. Their genetical constitution, as indicated by the output of germ cells, is very different. The nature of the germ cells produced is diagrammatically represented in Fig. 1 by the contents of the white circles on each animal. When two F1 animals are mated, two similar series of germ cells, each consisting of equal numbers of " red " and " black," are brought together.

Normally only a single ovum of the series produced by any individual cow will be fertilised, but the probabilities are equal of this being a " red " or a " black " ovum. If it is a " black " ovum it is equally likely to be fertilised by a " black " or a " red " sperm. In the former case it will give a true-breeding black: in the latter it will give a black of similar nature to the

F1 animals. If it is a "red" ovum it is also equally likely to be fertilised by a "black" or a "red" sperm. In the former case it will give a black of similar nature to the F1 animal; in the latter case it will produce a red. In considering the calf thrown by an F1 cow mated to an F1 bull, the possibility of its being red is 1 in 4, of its being a true-breeding black 1 in 4, and of its being an impure black (*i.e.*, a black that produces both "black" and "red" germ cells) is 2 in 4. If a large F2 generation from a number of F1 cows mated to F1 bulls were raised, we should expect the F2 generation to consist of blacks and reds in the proportion 3 : 1; further, of the blacks, only 1 out of 3 would breed true to black in the sense of producing only black germ cells. The others would act like the F1 parents and throw about 25 per cent. of reds if mated together.

The truth of Mendel's interpretation can be further tested by mating what are called "back-crosses," *i.e.*, by mating the F1 animals back to the parents. Suppose, as is shown on the left of Fig. 1 that the F1 cow is mated to the pure black bull. As the cow's germ cells are of 2 kinds, "red" and "black," and those of the bull are all black, we can obtain only two sorts of animals, viz., those formed by the union of a "black" ovum with a "black" sperm, and those formed by the union of a "red" ovum with a "black" sperm. The progeny will be all black in appearance, but while half of them are true-breeding blacks the other half will be capable of throwing reds when suitably mated. Again, if the F1 animal is mated with the recessive red as shown on the right side of Fig. 1, the germ cells of the F1 being "black" and "red" in equal numbers, and the germ cells of the recessive being "red," red and black among the calves would be obtained in equal proportion. Moreover, all the blacks so produced would be of the same constitution, *i.e.*, they would have the same output of germ cells as the F parent. No true-breeding black would come from such mating.

For the information of the breeder, the substance of the matter is that when a definite pair of alternative characters is being dealt with, of which one is dominant and the other recessive, only three classes of animals are possible: (*1*) the animal produced by the two *like* germ cells, both carrying the factor for the dominant character; (*2*) the animal produced by two *like* germ cells, both carrying the factor for the recessive character; and (*3*) the animal produced by two *unlike* germ cells, one of which carries the factor for the dominant, and the other for the recessive character. (*1*) is the true-breeding dominant, (*2*) the true-breeding recessive, and (*3*) the impure dominant,

which, though like the pure dominant in appearance, differs constitutionally from it in producing both "dominant" and "recessive" germ cells in equal numbers. The true test of the pure bred animal is that it breeds true, and this we cannot tell from its appearance, but only from the nature of the germ cells that it produces. Mendel's advice to the breeder is: "Think in terms of germ cells."

If the breeder wishes to prevent the appearance of reds in his herd he must eliminate the red germ cells, as these may be carried by blacks as well as by reds. The impure dominant blacks must be weeded out in order to be sure that red calves will not appear. Through Mendelism there is now a definite test that can be applied to determine whether the black is pure or not, and that test is to mate with the recessive; so mated, the true-breeding black will produce only blacks, while the impure dominant will produce an equal number of blacks and reds. This of course is a policy of perfection, and unlikely to be put into practice. Cows in a pedigree herd are too valuable to devote an appreciable proportion of their progeny to testing operations. But since red calves are never born of blacks, unless both parents are impure dominants, it is clear that the use of a bull which had been tested by mating to red cows, and shown to produce only black progeny, would be sufficient to prevent the appearance of red calves in a herd, whatever the proportion of impure dominants among the cows. In practice, therefore, the breeder would be well advised to make sure of the bulls by testing them, even though he did not trouble about the cows. But although nothing but blacks will be produced, the red germ cells will still be scattered about in some of the cows. He cannot be sure, without testing, that an animal sold out of the herd will be a pure black. Nevertheless if he makes use only of tested bulls the proportion of impure dominants among the cows will gradually decrease, and the possibilities of any beast sold being a true black will increase correspondingly. If, however, he uses a new bull without testing it, and it happens to be an impure dominant, a considerable increase must be expected in the number of red calves in later generations, for such a bull introduces as many "red" germ cells as "black," and must necessarily increase the proportion of impure dominants in the herd.

The breeder may reason that, provided the animal brought into the herd had a good pedigree, why should further trouble be taken? If its ancestry shows an unbroken line of blacks for, say, the last 10 generations, is it not practically certain that none but black calves will be thrown? The answer is that pedi-

gree is certainly *some* guide to breeding capacity. An animal with a line of black ancestry is more likely to be a true-breeding black than one that has a strain of red in its pedigree, but it is not a sure guide. The " red " germ plasm may be carried on by blacks for many generations, without coming into the open in the form of a red calf. This is illustrated by the imaginary pedigree shown in Fig. 2. The impure dominant cow in Gen. I carried " red " germ cells, and the " red " germ plasm passes down to her daughter, grandson and great-granddaughters.

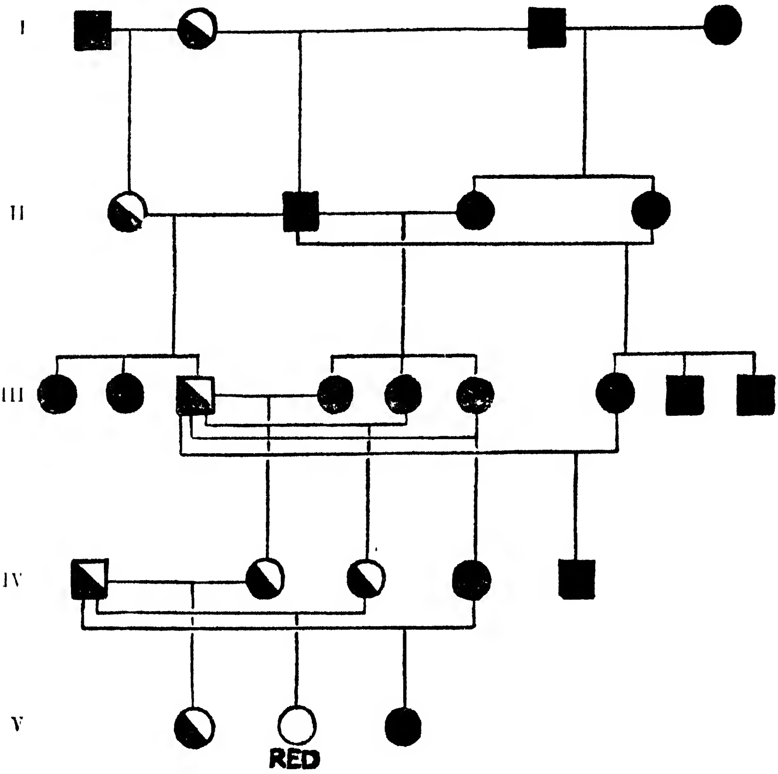

FIG. 2. Illustrating an imaginary Pedigree of Black Cattle. Bulls represented by Squares: Cows by Circles. True-breeding Blacks represented by full black: impure Dominants, carrying Red, represented half Black and half White.

No red calf appears because all of these animals, except the last, have been mated with pure dominants. But at Gen. IV a new bull is introduced which turns out to be an impure dominant, though it may have had only black in its pedigree for generations. If one of the great-granddaughters of the original cow is mated to this bull, it will produce a red calf in Gen. V. Had the breeder tested the bulls used in Gen. III and Gen. IV by mating them with red cows a proportion of red calves would have been

thrown. Had he then substituted for these animals bulls which threw only black calves to red cows he would have broken the sequence of the "red" germ plasm and established a true-breeding strain of blacks. Pedigree is a rough guide in estimating the possibilities as to whether the black belongs to the class of true-breeding blacks, or to that of the impure dominant blacks, but *certainty* as to the nature of the animal can only be arrived at by the direct test of mating to the recessive red. By using only tested bulls the breeder can be sure that none but blacks will appear in his herd. The true test of the purity of a given animal for a given character is not in its pedigree, but the nature of the germ cells that it produces. We now have a reasonable explanation as to why the "pure bred" beast may be nevertheless in reality an impure dominant.

The relation between the animal and the germ cells that it produces is the essence of Mendel's discovery, and must in future form the basis of the breeder's operations where purity of breed and character is desired. Where the character depends upon a single pair of factors, as in the black-red cattle case, the procedure for ensuring purity is simple; and there are a number of such simple cases in connection with farm live stock. Many of these concern coat colours because they are evident and easily worked out. The polled and horned characters in cattle form such an alternative pair, the latter condition being recessive.* Horned animals appear in polled breeds in precisely the same way that reds appear in black breeds, and the procedure for ensuring a herd true to the polled condition is the same as that for obtaining a herd of blacks which throws no reds. Further, Suffolk sheep are liable to throw inferior lambs with brownish markings in place of black. Records suggest that this character behaves as a simple recessive, and could be eliminated by the usual procedure.

The characters that breeders are concerned with are rarely so simple and distinct as the black-red case in cattle, for the possibilities rarely form a simple alternative pair as already described. Usually they are far more complicated, and all kinds of gradations are possible. Hence arises the question whether such complicated cases can be resolved in terms of a few definite factors showing a similar scheme of transmission. Will the general principle of heredity outlined above serve to cover the more complicated cases? Is Mendelism heredity, or is there any other kind of inheritance? These questions will be dealt with in the next article.

* Polled animals carrying the horned character sometimes show small "scurs."

NOTES ON FORAGE CROPS.

JAS. C. BROWN,
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A CONSIDERABLE range of forage crops is available to the farmers of this country, and several of these are well tried and have been grown for many years. There also exists a much more extensive array of forage crops, which, while obviously having great future possibilities, are at present debarred from being grown generally, through suffering from one or more weaknesses which make them uncertain in productiveness, or unsuitable in use. An extensive field awaits the improver of crops, but the importance of the opportunity has not yet been fully realised.

Lucerne.—Lucerne may be taken as an example of the need for improvement in fodder crops, as it seems certain that this plant could be made suitable to the varying conditions of soil and climate existing in this country. This crop has a habitat almost as wide as the wheat crop, and where it succeeds is unrivalled in productiveness. All attempts to render soil suitable by manurial treatment seem to have failed, and inoculation by bacterial cultures has not given very hopeful results, however effective in America. Throughout the world varieties of this plant are being developed suitable to particular regions, but in England no variety of this crop has as yet been raised which is adapted to the general conditions of agriculture of the country. In the United States Grimm's Alfalfa, has proved its superiority over the common varieties, while a most interesting series of hybrids of *Medicago sativa* and *Medicago lupulina* have been obtained in Canada. It may be hoped that some of the types obtained by the above crossing may be suitable for cultivation in Britain, and that they may possess the hardiness and suitability to the climatic and soil conditions of this country.

Bush Vetch.—Other examples of plants which admit of improvement are Prickly Comfrey, the Flat Pea and the Bush Vetch (*Vicia sepium*) particularly the last. This plant is, without doubt, one of the most valuable fodder plants indigenous to this country: herbage containing it is sought by cattle in preference to almost all other kinds, and greedily consumed. It possesses

a combination of qualities not found in any other pasture plant. It is extremely hardy, has a penetrating root, spreads rapidly, and produces heavy crops of high quality. If it could be developed as an agricultural crop it would solve the problem of clover-sick land, and further add to our pastures a crop equal in quality to wild white clover, and in productiveness to the ephemeral red clover. Sir John Sinclair speaks of a field in Scotland growing a crop of this vetch, and giving yields equal to Lucerne. In its wild state it is a far superior plant to the wild ancestor of the cultivated vetch, and but for a single weakness, would have been to-day one of our most prized farm plants.

The writer's attention was drawn to the plant many years ago by the preference cows showed for its herbage. Seeds were collected with a view to sowing a trial plot for grazing or mowing, but none of the seeds sown germinated. This failure was experienced by others, some of whom suggest insect attack as the cause, but it is more probable that the seeds resemble hard clover seeds.

It is only necessary to picture a field of the ordinary vetch with a permanent character to estimate the possibilities of this plant if it could be brought into cultivation. The writer tried for several years to obtain hybrids of this vetch with the cultivated vetch but failed.

Siberian Vetch.—Siberian Vetch (*Vicia villosa*) is another neglected species of vetch. It is largely grown in America, especially on very poor light soils, where it is known as the Hairy Vetch, and to a considerable extent in Russia and other continental countries. During the 18th century it was grown to some extent in England, and its chief characteristics were noted accurately.

Mills' Practical Husbandry published in 1762 says:—"Another species of Vetch, viz., The Siberian, hardly known I believe to the generality of farmers in this country, bids fair to become perhaps the most useful of all fodder; for its stalks grow to a great length, and are well furnished with leaves which do not decay in the autumn like those of the other sorts, but continue green all winter in defiance of the hardest frost."

The Siberian Vetch is semi-biennial in character, and should be sown after midsummer and before September; if sown in the spring it produces seed in August and afterwards makes a second heavy growth which continues until cut down by frost. At the

Harper Adams College it has often been growing luxuriantly, and flowering profusely in November. It is more hardy than the Common Vetch, makes an earlier growth in spring, and is more productive of foliage and flower, but the stems are harder and covered with hairs: also the plant appears to have a less watery composition. It yields seed abundantly in England, and owing to the small size of the seed a large number of plants are produced per bushel. Further, the plants branch profusely and fill up open spaces in the crop. Like the Bush Vetch, it will not hybridise with the Common Vetch.

Vetches.—From the earliest times the Common Vetch has been a favourite forage crop, and at the present time is one of the best of British fodder crops. It is especially valuable for providing keep for sheep, and it makes an excellent food for horses after the watery period of growth is past. For cattle and pigs, however, it is inferior to pea forage, and it has no significance as a seed crop. Vetches need more support than peas and are more difficult to harvest in good condition. A very heavy crop of vetch and cereal forage is liable, especially in wet weather, to rot near the ground, sometimes to the extent of a third of the crop, and to be laid flat. Makers of silage should consider the Harper Adams Soiling Crop No. VI, which does not lodge, and can be cut and carried without difficulty. The writer has not the experience to offer an opinion as to whether peas and beans are as suitable for this purpose as vetches, but in America oats and peas are commonly used.

Another member of the *Vicia* family which is worthy of the attention of the plant improver is the Narbonne vetch which has erect stems and does not require the support of other plants. In appearance it resembles the bean plant more closely than the other members of the vetch family: it is fairly productive, but somewhat delicate.

Vetches are not well suited for making into hay owing to their rapid deterioration under adverse weather conditions, the slow rate at which drying takes place, and their tendency to be over-run with mould in the stack. Well made vetch hay is good fodder, but pea hay is much superior. Vetches pulverise the soil but to a less extent than peas. Two British varieties are marketed, winter and spring, but the writer cannot distinguish between them. In 1916 the winter vetches sown in September were killed by frost, those sown in

November survived. Two new varieties have been placed on the market by the Svalof Plant Breeding Station, and for spring sowing they appear to be more productive than the common kind. They produce more leaf, and there is a difference in the character of the flower.

The Pea.—The pea has considerable claims to be regarded as the most important forage crop for feeding to cows and pigs. For sheep, in the green state, it is less suitable than vetches, and if fed in too large quantities will cause stomach trouble, but the dried haulm is prized by flockmasters for feeding to sheep folded on roots. At all stages of growth the pea plant is a suitable food for pigs, a fact which was well understood in byegone times, as the following statement from Mills' Practical Husbandry shows :—

"The farmers of Staffordshire frequently sow on poor light shallow land, a small white pea, which they never reap but turn in as many hogs as they think the crop will fatten, and let them lie upon it day and night."

Peas succeed on a wide range of soils, and can be grown successfully in all parts of the United Kingdom. They give the highest yields of forage on land containing a considerable percentage of clay, and they prefer a lumpy tilth to a finely prepared soil. Field peas may be sown for forage at any time from the beginning of November until the middle of June, and a succession of pea forage can be obtained by sowing at intervals. The pea is a useful crop for reclaiming very light soils if sown early in the spring, while it can be cultivated successfully in many districts on the New Red Sandstone, where satisfactory crops of oats cannot be obtained. This land is poor in lime and rich in magnesia and overrun with the weeds fumitory and mayweed.

Experiments with Field Peas.—In the soiling experiments, the garden pea was first used, but failed entirely owing to an insufficient root system for field conditions. Experiments were carried out later to test the relative value of field peas, with the following varieties:—Svalof Grinding pea, Svalöf Concordia, Svalof Capitol, Svalof Solo, Golden Vine, Bangalia, Kaiser, Wisconsin Green, English Gray, Dun, and the Maple pea.

Of these the English Gray, Dun and the Maple proved the most luxuriant growers, but the Golden Vine also gave good results. All field peas have succulent stems until the flowering period, but after that time the stems harden rapidly, whereas those of the garden pea do not become so woody. Infinite pains

have been taken to improve the garden pea, because of its value as a human vegetable food, but comparatively little has been attempted in the way of improving the field pea in England, although new varieties have been introduced by the Svalöf Plant Breeding Station, and by the experiment stations of the Department of Agriculture of the Dominion of Canada. If, however, the wild pea which Mr. Sutton brought from Palestine is the ancestor of the field pea, unrecorded but very successful efforts must have been made in the past to improve it. As in the case of the common vetch, the cultivated varieties of peas are immeasurably more productive than the wild ancestor.

Mendelian Experiments.—In the tests made at the Harper Adams College it was shown that the varieties in general cultivation in England are the best at present obtainable, and as these leave much to be desired as fodder crops, a series of hybrids was made with the most luxuriant growers among the garden peas. A Mendelian scheme was planned but the F2 generation was too complex for the original scheme to be followed up with any hope of immediate success. The results are interesting. To give an example, a cross of the Gladstone garden pea with the maple field pea yielded green, blue and yellow seeded peas, both round and wrinkled in each case, all of which have been fixed. As regards vegetative characters, both the parents being tall, the appearance of a considerable percentage of dwarf plants was a surprise. The object of the experiment, was, however, to breed an improved Soiling Pea in the shortest possible time, and for this purpose fourteen of the most luxuriant plants were selected, and tested, those possessing unstable characters or showing weaknesses were eliminated. The type finally selected has much more foliage and stem, is a more rapid grower, and is less woody than the field pea. Attempts made to improve the pea as a soiling crop revealed the possibility of improving the plant as a seed crop. Owing to long and persistent efforts the pods of the garden pea have been increased in size, while those of the field pea have remained comparatively small. By crossing with the garden pea, and making selections, it has been found quite easy to increase the size of the pod without reducing the number of pods per plant, and types have been established especially suited to growing in mixture with oats to be harvested for seed.

Mixed Pea and Oat Crops.—It has for long been a practice in the neighbourhood of Market Drayton to mix peas with the

oat crop to be harvested for thrashing, but the difficulty has always been to prevent the crop becoming laid. The only precaution possible is to keep the proportion of peas small. If the mixture is to be harvested in sheaves, it is necessary that the pea should ripen in advance of the oats. A mixed crop of peas and oats is one of the means by which the grain yield of weak soils can be raised. It is possible to grow the mixture successfully on soils which will not give a profitable crop of oats. The presence of peas in a crop of oats seems to increase the growth of the oats, and particularly in respect of the size and yield of the ear. The chief drawback to the crop is the risk of its lodging as a result of the heavy load of grain it carries.

It is hoped that the new peas, with light foliage, comparatively short stem, and early ripening, will help to make this mixture popular, especially on soils where the oat yield is below 40 bush. per acre. On really first-class oat soils the mixture would not be satisfactory. In combination with Duns oats a mixture of peas and oats gives the heaviest hay crop obtainable.

Cereals.—All the cereals, when cut green, are good fodder for all kinds of live stock, and there appears to be little to choose between them; the oat, however, is considered the most suitable.

Rye is important because of its earliness, and its ability to grow during the winter months, but unfortunately its period of usefulness is short, as the stems become hard much more rapidly than in the case of the other cereals. It is rejected by live stock after seed formation has commenced. Three varieties are known in England, Common Rye, Giant Rye, and St. John's Day Rye. Giant rye gives the earliest and heaviest crops. Many other varieties exist throughout the rye growing districts of the world, but these have not yet been tested in this country.

Barley, in its early stages of growth, is preferred to all other cereals by sheep which will pick out this plant first in grazing. For feeding to cattle, however, the awns are a drawback and are disliked. Barley can be sown later than oats with the certainty of securing a satisfactory crop. The winter barleys are most suited for the purpose of fodder cropping. A recent introduction is Manchurian barley, which owing to its leafy and rapid growth, appears to have superior possibilities as a forage crop.

Wheat, cut green, is excellent fodder, and a mixture of wheat and vetches stands much better than mixtures of barley and vetches, or oats and vetches. In districts which lie at too high an altitude to ripen wheat, and where it grows luxuriantly, it is worth while considering the growing of wheat for dry fodder to be cut in the milk stage, tied into sheaves, and dried in the stook. Cattle thrive remarkably well on wheat straw harvested in the green stage. Browick Grey Chaff wheat, owing to its hardiness, is recommended, but it is hoped shortly to put into cultivation varieties specially raised for the purpose of giving large yields of stem and leaf.

The oat has always been recognised as one of the best of the cereals for fodder, particularly the old varieties such as Clemrotheray, the seed of which can be obtained in quantity. The modern seed oats are unsuited to the purpose, because of their habit of growing thinly on the ground, and their want of hardiness. By far the best of all oats for forage is the variety known as Duns, which unfortunately is not in general cultivation. It is the ideal forage oat, it grows densely on the ground, is leafy, succulent, tall, and stands well, and it is difficult to imagine how it could be improved. At the Harper Adams College, during a year of badly laid corn, a field of Duns oats, although six feet high, remained erect at harvest time. The ears are light but large, and the grains long and lean, in consequence of which it does not give yields of grain on good land equal to those of the grain oats. A great point in its favour as a fodder crop is its lateness, and its slow ripening; it remains green and succulent for a long period. It consists of many types, and could be made more uniform by selection.

Buckwheat.—Buckwheat has long been known as a useful forage crop. Mills among other writers speaks well of it. He says:—

"Milch cows fed on buckwheat will yield an extraordinary quantity of milk, remarkably good for making into butter and cheese, and another advantage attending this pasture is that it will continue green in the driest time of summer when other grass is burnt up." [6]

Buckwheat has been grown and fed successfully at the Harper Adams College in conjunction with peas and rape, and the writer urges a trial of this mixture by those who have poor light soil. Buckwheat will grow on the poorest soils, and if the crop were eaten off by sheep the land would be in a con-

dition to carry a crop of winter barley, even on soils too poor to give a profitable crop under ordinary methods of cultivation.

Beans.—The bean plant is quite good forage, and is readily eaten by cattle, even the thick hard stems. Sheep do not eat the bean plant if other fresh green food is available. The bean has a special value in forage cropping, as it is the only forage plant which can be trusted to remain erect under all conditions, and which can be sown at any season of the year. For cutting green, the common winter horse bean is the most suitable. For spring sowing for seed production, the Mazagan is the most satisfactory. As in the case of the pea the roots of the bean pulverise the soil and leave it enriched for the following crops. In making mixtures containing beans it is necessary to sow at least one bushel per acre to obtain the strength necessary to support a heavy crop of trailing plants.

THE HUMAN MACHINE ON THE LAND.

W. J. MALDEN.

IT is not necessarily the strongest labourer who does the most work or who is the least tired at the end of the day. Much labour at the present time employed in arable farming is inefficient, and consequently energy is misdirected. Assuming that 100 per cent. represents the efficiency of a labourer of all-round skill, the average for the whole country to-day is not more than 60 per cent. Something like £100,000,000 is paid yearly in wages. Forty per cent. wasted through inefficiency is a big charge on the land and the country. When several millions of acres went from the plough in the 'eighties and 'nineties of the last century, and the rural population largely drifted into the towns and industries, the farmers lost a big portion of the highly skilled men, and many of their more promising sons. Roughly £1,000,000,000 was estimated to have gone out of farms and land capital in those years, and a proper wage reward could not be paid to the labourers.

The War made a heavy call on the men of the land, and many skilled labourers have, as a result, been lost to the industry. Without skilled labour full farming cannot be carried on, but what signs are there that anything is being done to train men to a higher efficiency? Yet the time must come when much of the land will go out of cultivation, unless workmen be endowed with more skill. We are in a fairly mechanical stage on the land, and doubtless invention will come further to our aid, but though a percentage of trained mechanics will be required, it seems perfectly safe to state that in a few years a highly skilled farm worker will command very high wages. The skilled man on the land, able to turn to any kind of live stock, good in the hay time and harvest, a skilled hedger, in fact not lost anywhere, has become a very rare man. If he can do a few of these things really well, he can pretty well make his own terms, and he will be in greater demand as years go on.

In many districts labour has so fallen in skill that farmers have accepted a very low standard, being in fact glad of anything that will see them through at all. The farm worker has descended very much from a farm artisan to a farm labourer; he is often possessed of little skill, and having little joy in his

work cannot take the pleasure in it that his fathers did. Work done in that way becomes drudgery. In saying this one makes many exceptions. In all ways something is needed to bring about better conditions, to give the farm workers a greater interest in their occupation, and to make their lives more valuable to themselves and to others. Interest must be aroused in their work. They should be made skilled so that they may feel an honest pride in their work just as they should in their play.

Farm Labour as Farm Athletics.—I have always regarded physical work on the land as farm athletics. This is probably due to the fact that I was reared in a district where work was exceptionally skilled, and where competitions in the arts of husbandry excited as much interest as a local football match does to-day. As a native of Bedfordshire, I was brought up under the direct influence and outcome of those remarkable historic Woburn Sheep Shearings which began towards the end of the 18th and continued into the 19th century. It was in them that the great effort of the Dukes of Bedford, Coke of Holkham, Ellman of Glynde, and other giants of those days set themselves to wake up farming from the sleep in which it had slumbered for some centuries. These gatherings were notable in that they instituted in a broad manner competitions by workmen in acts of husbandry. These farm workmen's competitions acquired world wide repute, and before the 19th century opened a few county agricultural societies were founded, mainly to further skill in farm labour. Naturally from immediate association Bedfordshire inaugurated a Society; and until quite late in the century when hard times in farming stopped them for a few years the competitions aroused the greatest enthusiasm, and exercised a big influence. Farmers and workmen shared equally in the spirit of emulation aroused, and the county ploughing matches even sixty years ago were the hunting ground where the large agricultural machinery firms sought men of skill and resource to be taken to demonstrate the value of their implements and machines throughout the world. Further, the market gardens and the seed growing areas in the Biggleswade and Potton district developed men of skill in the handling of tillage tools. Thus, in that and the surrounding counties, arose an all round skill hard to excel. Skill made work easy to the men, competitions aroused enthusiasm, and enthusiasm led men to work with a will. It was not a question of one man being set apart

to do a particular job; every man expected to be an all-round hand.

Suggested Inter-County Competitions.—There are many men farming successfully to-day who owe their success mainly to taking up farms where their predecessors had trained the men to skilled work. Had they not found them they could not have trained them. It is of little use to find fault with bad work if one cannot show the man the right way. In rather a widely varied life on the land I have found nothing so valuable to me as those few years when I took part in and learned farm work from the skilled artisans amongst whom fate threw me, and every youth going on to the land should make as much study of it as of any other section. I should like to see teams of young farmers of one county challenging those of other counties in a wide range of acts of husbandry; inter-county contests between the farm workmen, with a challenge shield for the best county; and inter-school contests between schools in different districts. It would be far more exhilarating than seeing two parishes playing indifferent football! Few have thought what a lot may be learned in farm work in a village school playground; and how a simple training may teach much that is useful. All sports and physical work should be learnt when one is young.

Training in Farm Labour is Easy.—However, training in farm labour is a very simple thing; and is capable of being taught easily and systematically. That amongst older men, there would be opposition to this there is no doubt, and many who have tried to inculcate fresh methods have met a resistance which has caused them to discontinue their efforts, as they have found that sometimes it is better to carry out a bad method well than a good method badly.

In systematising work I have followed closely the practices in the more strenuous sports. No matter what the physical work or sport, no one commences to do it in the right way, whether it is handling a golf club or a scythe, and unless the proper way is shown little skill is obtained. It has to be remembered that a man is a machine—the most wonderful machine in the world—capable of doing any work performed by the most intricate machinery. He is superior to farm animals because they are horizontal machines capable of doing work only in a straight line forward or backward. Man is a hinged vertical machine not only doing this, but able to stoop and lift heavy weights vertically, which a horse cannot do.

Also he has lateral action; by a heave from his hips and a shoulder jerk, he can pitch a sack of wheat sideways some feet clear of himself. He also has linked action through the arms by which he gets arm swing in association with body swing, and so can use a scythe or an axe, and throw heavy bodies from side to side by hand grip. Again, when using a tool he can get an up and down action from arms and body, as in pumping or threshing with a flail. He can also pull with the arms, using body weight. He can utilise the back swing over the hips, together with the leg drive, as in rowing, hoeing, or tug-of-war. He can lift upwards as in digging, or pitch sheaves, or swing a long hedging bill. In fact there is practically no action or combined action he cannot perform. His hinges at the ankle, knee, hips, shoulders, wrists and fingers are under the influence of muscles and tendons, which flex and give rise to powerful actions, which are often assisted by dead weight, and their proper use takes advantage of leverages; moreover, with tools in hand a man finds leverage from these as well as from outside conditions. We do not think of ourselves as machines until we go in for sports; yet a skilled athlete is but an expert artisan in an unproductive calling. A man with skilled training takes little out of himself as compared with one untrained. It is the same in all farm work; brute strength is helpful, but a weaker man who has got the knack can beat the unskilled any and every time, just as an old man who is skilled is worth more on a farm than a young one unskilled.

"Putting one's back into work" means much more than mere exertion, it means using one's force and dead weight to the best advantage. The greater part of all heavy work should be done by the back and legs through leverage and momentum obtained through the joints or hinges, and to a large extent these are obtained merely by skill in actuating them, viz., learning how to apply them to the best advantage. The arms and hands are convenient means through which the power is transmitted to tools, they give "finish" of work, and add to celerity. Knack is merely a proper co-ordination of mind and muscle brought to the position where effort is not needed to work them together; but one may have a bad knack so it is necessary to learn the correct method of working.

When the best method of working is decided upon, it will be found that it comprises a certain number of actions to complete an operation: and these actions will be repeated in the same sequence in each operation. I have analysed the various

operations into individual actions, eliminated the wasteful ones, and taught the others separately. Next they are run together and operation is linked to operation. As these are repeated there must be an easy connection between them making a series of smooth movements each similar, but necessary for continuous work. We see it in mowing, hoeing (when done in the proper manner), digging, axe work, planting cabbages, &c. Finally, the human machine tunes itself up to a speed compatible with endurance through an average working day.

Need for Intelligent Observation.—However, the human machine should be made to bring its intellig nce to bear, to realise its powers, and the mechanical forces within it. The simplest laws of mechanics must be followed. These can be taught very simply and quickly by simple illustration. It may be mentioned that little effective work can be done with the legs straight and rigid. The body and legs must relax, otherwise the rocking and rolling actions obtainable about the hinges or joints at the hips, knee and ankle, so necessary to give effect to body swing, either fore and aft or laterally, cannot be obtained. They give an opportunity to take advantage of good footwork and stance—two of the first essentials, as they afford the opportunity to make use of momentum, and to regain equilibrium, without which rythmical actions will not be maintained.

Then again relaxation is needed to allow the body to go down to the squat or crouch to do any work where stooping is required, and to do it without a backache—as in cabbage planting. The body must always have an easy balance or poise, or it will be overbalanced, so that power is lost and a proper sequence of actions cannot be taken. It is not necessary to go near to a man to see if he is working properly; it is shown as soon as he can be clearly seen. Sufficient proof is afforded by the fact that a man keeps time with himself throughout his work. It may be clearly seen whether a man works inside his work, or uses a tight grip where he should use the running hand, or uses the ham knuckle jerk in lifting a sheaf on to a wagon or rick, or is using his body leverage and not merely an arm lift or swing. Whether he understands the simple laws of levers as applied to the mechanism of his own body, has some knowledge of a suitable line of draught, realises the advantage of using his reach, has a notion of timing an action or values the effect of wrist work and other points, is discernible to anyone who has a proper knowledge of skilled workmanship.

Simple Instruction.—By simple demonstration all these are easy to teach to the old or young. It is so simple that it can be taught to children of almost any age, and could be taught in any village school playground; moreover, a boy leaving school at fourteen could be trained thus in many necessary forms of work, and be skilled in work, whereas otherwise he would go on to a farm without skill, and often by working where poor skill prevails, even after a lifetime on it would remain inefficient.

That strength is not the ruling influence in effective working I recently demonstrated through a cinematograph film showing girls after three months' training doing very varied work, including most of the heaviest done on the farm. By the proper application of their powers they were able to work without undue fatigue, they got the knack of doing the work in the most effective manner, and they worked with perfect rhythm.

It may be taken as a pretty safe axiom that if dung is loaded and spread by long handled forks, if hoeing is done by dub-headed hoes instead of swan necks, and if hedges are trimmed back with short (one handed) swaps or fagging hooks, then the standard of work generally is a low one, whilst the absence of cabbages in a stock raising district is pretty good evidence that the men have not learned to stoop without making their backs ache. Yet nothing is easier than transplanting done skilfully. With a proper stoop there is no need for back ache. In many districts there is not a man who can plant 2,000 cabbages a day, yet after short training they are able to do it, and find it easy to plant 5,000. Where this is done the crop is cheaper and more reliable than any other form of root growing.

In view of the large number of persons who have come on to the land wholly unskilled, with little likelihood of training whereby they will become skilled, whether they come as workmen, small holders, men from the services. allotment holders, who are spending energy with small results, one cannot fail to see the low efficiency on the land. Boys come to the land as stop gaps with no knowledge, skill, or incentive to work. They think that a fixed wage now will see them through life, but without skill it will not. Any training or incentive to skill is sorely needed to restore and maintain craftsmanship in agricultural labour. It is necessary if the land is to be kept under cultivation. The significance of this is obvious.

THE IMPROVEMENT OF PEATY SOILS.

PART II.—THE SILTY AND SANDY PEATS.

E. J. RUSSELL, D.Sc., F.R.S.,
Director of the Rothamsted Experimental Station.

In Part I of this article, published in the March issue of the JOURNAL, *p.* 1104, *Dr. Russell gave an account of the "True Peats" in low-lying and high-lying districts, and the method of reclamation.*

THESE soils form a transition between the true peats and true soils; they arise in conditions where bacterial action goes on more slowly than in ordinary soils, but more quickly than in true peats; organic matter, therefore, accumulates but without forming a separate vegetable layer. They may also arise when a true peat, after drainage, shrinks and finally disappears, again exposing the old surface on which it had rested.

In general these soils present greater possibilities of reclamation than the peats. They usually have the same defects as the peats, viz., wetness, acidity and lack of phosphates, but in a less intense form; it was through these defects that the soil bacteria were unable to complete their work, and until they are remedied crops cannot make proper growth.

Silty Peats.—An interesting example of the silty peats is found in Bodmin moor, Cornwall. The elevation is 800 to 1,000 ft. and the rainfall probably about 40 to 50 in.; both are high enough to interfere with ordinary agricultural processes and with the decomposition of plant residues in the soil, but the conditions are more favourable than on the higher lying Dartmoor, and in consequence there is considerably less deposit of layers of peat. The composition of much of the moor soil is different from normal agricultural soil in its higher content of organic matter, but it is by no means as far removed from normal soil as is peat.

It is possible also that peat may have occurred on some of these areas, but if so it has been denuded subsequently faster than it could be reformed. Some of these soils have the composition shown in the table on the next page.

In all cases except Laneast the surface soil was black, underlain by a band of broken stone; lower down was a reddish yellow subsoil. Where drainage is possible there is no insuperable

	Surface Soils					*Subsoils*		
	Wilsey Down		Laneast Down	Davidstow Moor	Cardinham Down	Wilsey Down	Laneast Down	Davidstow Moor
	Cultivated	Wild	Wild	Wild	Wild	Wild	Wild	Wild
Fine gravel ...	3·2	2·5	3·9	1·6	10·4	2·1	6·1	2·7
Coarse sand ...	9·5	6·3	1·8	1·5	17·8	6·3	3·9	1·7
Fine sand ...	26·3	31·5	20·2	15·4	16·4	32·4	19·2	14·1
Silt	18·1	20·5	21·3	33·9	13·6	17·0	18·2	34·1
Fine silt ...	25·8	19·1	25·2	17·0	11·0	24·0	28·4	18·8
Clay	2·4	1·8	4·5	3·1	3·5	6·0	9·1	11·2
Stones		12·5	12·4					
Organic matter	9·1	11·9	15·1	19·5	17·0	6·2	8·6	12·1
Nitrogen ...	0·31	0·35	0·46	0·63	0·48	0·15	0·23	0·29
Carbonates ...	nil	nil	nil	trace	nil	nil	trace	trace
Acidity ...		present	present					
Lime requirement		0·48	0·67					
Total potash (K_2O) ...		0·21	0·53					
Phosphoric acid (P_2O_5) ..		0·04	0·10					

difficulty about reclamation; some has been carried out already on Wilsey Down. The first ploughing is heavy because of the broken stones, sometimes the work proves even dangerous when done with a horse plough; there is less difficulty with a tractor. More important perhaps than anything else in these high districts is the selection of suitable varieties of crops. The Cornish oat—"American"—is still grown on the old moorland farms as it has been for 40 years past. Preliminary trials indicate, however, that some of the newer sorts such as "Yielder" and "Golden Rain" may prove distinctly better. Phosphates (superphosphate or perhaps basic slag) should be liberally used to hasten ripening of the cereals and to improve the feeding value of the rape and seeds grown for sheep feeding. Nitrogenous fertilisers and lime are also likely to be effective. There is much room for carefully considered experiments on the improvement of these soils.

Another group lies at lower altitudes and under a smaller rainfall; it offers even better prospects of reclamation; examples are found in the Staddon grits of the Lower Devonian series at Newlyn Downs and St. Brioch's, Cornwall. Analysis of the soils gave the results shown in the next table (there are no important differences between the waste and the cultivated soils). An example of reclamation of this type of land is seen on Tremollet Down where a tract of 280 acres was taken into

	Newlyn Downs		*St. Brioch's.*		*St. Brioch's Subsoils.*	
	Waste.	Cultivated.	Waste.	Cultivated.	Waste.	Cultivated.
Laboratory number ..			10	11	10	11
Fine gravel	8·7	7·4	2·4	4·7	3·9	3·5
Coarse sand .	9·2	5·5	6·1	8·5	7·4	7·2
Fine sand	20·3	18·3	28 9	22·8	29·4	21·3
Silt	21·2	27·8	17·8	30·3	16·2	33·9
Fine silt ..	17·5	15 3	20·8	12·9	21·0	11·0
Clay	6 6	10 0	9·3	6·6	9·2	11·5
Stones			20	15	17	24
Organic matter ..	7·6	9·2	9·6	9·0	6·1	6·9
Nitrogen	0·21	0·27	0·23	0·30	0·10	0·15
Carbonates . ..	nil	nil	nil	0·02	nil	nil
Acidity	present	present	present	present	present	present
Lime requirement .			0·06	0·23	0·37	0·21
Total potash (K_2O) ...			0 35	0·55	0·48	0·32
Total phosphates (P_2O_5)			0 03	0·07	0·01	

cultivation by the Duchy of Cornwall in 1909-10 at a cost of approximately £11 per acre. Since the land readily lets at £1 per acre the project has been profitable. The gorse and heather were burnt, and the land was ploughed; no further treatment was needed. The chief expense was incurred in making the road through the land and in setting out and enclosing the fields. These are of 8 acres each and fenced in with the usual Cornish earth wall faced with stone, on the top of which hazel and other bushes will grow; substantial fences are needed to shelter the live stock. The main feature of the farming is stock raising, and the farmers usually adopt the following rotation—oats, roots, barley, seeds mixture—which is then left as long as possible; some of it has been down too long and is beginning to be weedy. The land obviously needs lime which was not applied as part of the reclamation: spurry, sorrel and polygonium are all common on the stubbles, but the reclamation has been a complete success.

Sandy Peats.—Numerous instances of these soils occur in Cornwall, and they are commonly in bad repute. Few people who know them speak well of the black granite, or as they are locally called "growan," soils of Cornwall, yet there seems no reason why they should not be cultivated. Some of them are very acid—one indeed is the most acid soil the writer has found in England—but this could be overcome by a sufficient dressing of lime.

The following analyses of soils are taken from the St. Buryan's district, between Penzance and Land's End; for purposes of comparison the values for a highly fertile potato soil near Penzance are also given:—

	Trevidder Moor.	Near Boscawen.		Ludgvan, Penzance.	
	Waste.	Waste.	Cultivated	Highly fertile potato soil.	
				Surface.	Subsoil.
Fine gravel	21·0	9·3	8·0	2·8	4·6
Coarse sand	40·9	18·1	16·4	9·7	11·6
Fine sand ...	6·6	20·5	30·8	57·6	46·9
Silt	8·1	21·1	17·2	2·9	9·4
Fine silt	4·7	8·8	9·2	7·4	9·2
Clay	1·1	2·2	1·5	1·4	1·3
Stones .	32	15	10	23	
Organic matter (loss on ignition)	11·8	13·2	10·0	8·8	9·4
Nitrogen	0·34	0·39	0·37	0·19	0·19
Carbonate (as calcium carbonate)	nil	nil	nil	3·2	2·6
Acidity ..	present	high	present	absent	absent
P_H value * .. .	4·8	4·6	5·2		
Lime requirement for neutralisation † . .	0·40	0·73	0·44	none	none
Phosphoric Acid (P_2O_5) Total ...	0·10		0·08	0·25	
Potash (K_2O) Total ..	0·52	0·28	0·54	0·44	

*This measures the intensity of the acidity but not the quantity; 7·2 is the neutral point and the lower the P_H figure the greater the intensity.

†This measures the quantity of acidity and also the amount of lime absorbed in other ways. The Hutchinson-McLennan method is used.

The soils were all deep, and the subsoils, both at Boscawen and Trevidder, closely resemble the surface soils; the figures are omitted for the sake of brevity. Other waste areas in the district were similar in character to the Boscawen area; the analytical details need not, therefore, be given.

All that these waste soils need is clearing to remove gorse and bracken, then deep ploughing, finally a good dressing of lime and phosphates. The smallness of the difference between Boscawen waste and cultivated land shows that there is nothing in the soil to prevent cultivation. There are, of course, marked differences from the fertile potato soils of Penzance, both in the soil and even more in the position, but these could be used for several types of farming and for either small or large holders.

NOTE.—References to the literature on this subject may be obtained on application to the Ministry.

POTATO GROWING IN ESSEX.

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THE potato is one of our most important farm crops, and can be cultivated successfully and profitably on all soils in this country with the exception of the heaviest clays. In order, however, that the best results may be obtained, it requires "good farming" both as regards cultivation and manuring.

In an ordinary farming rotation, potatoes are taken between two corn crops, and are a very good cleaning crop.

Cultivations.—The great mistake made by so many potato growers is to give too little cultivation. They manure their land well with farmyard manure in the autumn, and also apply a liberal dressing of artificial manures in the spring. They then keep their land reasonably clean, and of course are disappointed if they do not get the maximum yield; but the first, last, and all-important thing in potato growing is deep cultivation and plenty of it, up to the time when the tubers are forming, when of course all cultivations should cease.

Useful Hints on Cultivation.—Ploughing should take place as soon after harvest as possible. to a depth of at least six or seven inches. A subsoiling plough should come directly behind the ordinary plough, subsoiling an additional eight or nine inches. The subsoiling plough should not bring any soil to the top, but only break the subsoil, getting it into a good mulch below. The land should then lie open until the spring, and then, if the soil and weather will permit, it should be cultivated deeply, preferably by steam tackle, but if steam tackle is not available, a strong tractor will do the work. This cultivating should be at least seven or eight inches deep. The land should then be well harrowed until a level top is obtained. To economise in labour it should then be ridged with a ridging machine which makes two ridges (baulks or drills) at each operation, at the same time sowing the artificial manure. This is a good way to apply artificial manure, as a little of the mould rolls on top of the manure, and the seed tuber does not come into direct touch with it. The baulks should be about 27 inches wide.

Methods of Planting and subsequent Cultivations.—The seed potatoes should be planted directly behind the ridging machine, the tubers being covered in with a double-breasted or moulding plough. One horse should always walk on the top of the ridge so as not to displace any of the tubers in the furrow.

About a week after the planting the ridges should be harrowed down with light harrows, care being taken not to harrow the baulks too flat, otherwise the tubers may be disturbed. After the harrowing they should be horse-hoed (with two horses) to a depth of six or seven inches between the rows, and then moulded up with a moulding plough. About ten days or a fortnight later a shim should be run under the potatoes, taking one baulk at a time, and shimming to a depth of four inches below the seed tuber. An implement, commonly known as a potato shim, is used for this operation. This will put the whole of the land into a proper mould or mulch. In some cases the results are very beneficial, but in others when the weather is very dry, and the ground very rough, shimming would result in a loss of moisture, and the farmer must therefore use his own discretion. In a case such as is mentioned above the ridges ought to be harrowed down again with saddle-back harrows, and horse-hoed again. The land should then be left until the potatoes are three or four inches through the ground, when they should be hand-hoed, all the top soil being moved, whether there are weeds or not. This should be followed by another horse-hoeing, and when the potatoes are high enough they should be well moulded up. This should finish all cultivations.

Manuring.—This is a matter on which there is considerable difference of opinion, but after many years of practical experience the writer has no hesitation in recommending the following methods.

As soon as possible after harvest, 15 tons of good, well-rotted farmyard manure should be applied to the stubbles and ploughed in. In the spring, just before planting, there should be applied a mixture of:—

$$\left.\begin{array}{l}1\tfrac{1}{2}\text{ cwt. Sulphate of Ammonia}\\ 5\ \text{ cwt. 30 per cent. Superphosphate}\\ 1\ \text{ cwt. Sulphate of Potash.}\end{array}\right\}\text{ per acre.}$$

If farmyard manure is not available for the potato crop, a liberal dressing of organic manure should be given, which will to a certain extent take the place of farmyard manure. This organic manure should be either bone and meat meal, hoof and horn manure, or fish guano, and should be applied at the rate of about 8 cwt. per acre, while a mixture of 1½ cwt. sulphate of ammonia and 1½ cwt. sulphate of potash per acre should also be applied. The application of sulphate of potash to light land will be specially beneficial.

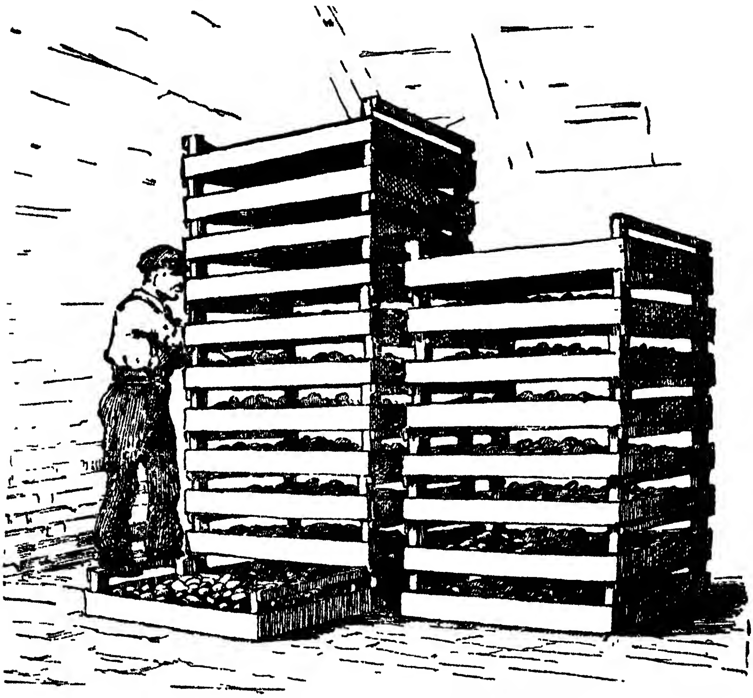
Planting.—Planting is an operation which requires more

attention than is usually devoted to it. Early varieties for the early market should be planted about ten inches apart, and main crop varieties should be planted from fifteen to sixteen inches apart. Care should be taken to see that the seed tubers are planted with equal spaces between them, as if they are planted too closely together the plants will be crowded and the result will be a large proportion of small potatoes. If too much space is left between the tubers ground will be wasted and weeds will have a better chance. Some farmers use a marker, consisting of a wheel with movable spikes which are set to the required distance and the wheel is then pushed along the furrows making small holes at even distances for the seed tubers. Where such a marker is not available it is a good practice for the man in charge of the planting to have a stick cut to the length of the required distance between each potato, and he can then measure the distance at which the workers are dropping the potatoes, and give them a clear idea as to exactly how much space is to be left between each tuber. Some farmers plant potatoes at a distance of twelve inches apart, believing that they will get a larger crop, but while they may get a larger number of tubers, the total yield of good marketable ware potatoes will be less; and a good crop of ware potatoes is what we should aim at.

Boxing.—The boxing of early varieties should be done in September or October, and the boxes stored in a house or barn suitable for the purpose. A suitable house must have plenty of light, with a window or large loop, which can be opened every day when the weather is open, on each side of the house, in order to get a proper current of air through. Under these conditions the potatoes will give hardy, stubby, purple shoots. Care should always be taken to pack the boxes correctly; if they are packed too closely, long, white spindly shoots will be found on the potatoes in the centre of each box, and this should be avoided (see sketch). The boxes should be moved at least twice during the period, the top boxes being put below and the bottom boxes on top.

The boxing of late varieties is a very debatable point. If the date of planting is to be very late—say the end of April or the beginning of May—the potatoes ought to be boxed; but if planting, particularly with late-sprouting fresh Scotch seed, is to take place between the end of March and the middle of April, so that the first sprouts are formed in the soil, little advantage is to be gained by boxing.

Seed.—It pays the farmer to sow good seed for all crops, but the seed is of special importance in growing potatoes. The benefits derived from change of "seed" are now generally admitted, but some growers are not sufficiently particular as to the source of their new "seed" potatoes.



Boxes for Sprouting Potatoes.

It is generally admitted that Scotch seed potatoes yield the best crops, but still a large number of farmers cling to the belief that "once-grown" seeds (*i.e.*, potatoes grown in England from Scotch seed) will yield crops equally as good as those grown from seed direct from Scotland. Satisfactory results are undoubtedly obtained from "once-grown" seed potatoes in those parts of the country which have a fairly heavy rainfall, but in the drier parts (the south-eastern and home counties) far heavier crops are obtained from Scotch seed than from "once-grown" seed potatoes, although in a year with a heavy rainfall during the growing season occasionally the latter will yield crops almost equal to those obtained from the Scotch seed. These, however, are the exceptions which prove the rule, that in the dry eastern counties fresh Scotch seed should be planted every season. Not only in the weight of the crop is the advantage of the new seed

to be reckoned, but the crop grown from new seed is generally more sound and marketable than a crop grown from "once-grown" seed. Some farmers, while admitting that larger total crops are obtained from new seed, incline to the opinion that a larger percentage of ware (large size tubers) is obtained from "once-grown" seed, but experiments conducted by the East Anglian Institute of Agriculture (see Report on Field Experiments for 1914) do not confirm this.

Considerable differences of opinion exist as to the best seed size, but generally speaking it is found that seed dressed through a 2-inch and over a $1\frac{1}{4}$-inch riddle, although taking a fair weight per acre, give more satisfactory results than those obtained from smaller seed, with the exception of the first-early variety, Epicure, which seems to grow equally vigorously from very small tubers.

Varieties.—Local conditions largely influence the varieties which should be planted, but, speaking generally, one may say that for the production of potatoes for the very early market Epicure is a prime favourite, followed by Eclipse, which, although of better quality and shape, and a heavier cropper, is a little later than Epicure.

It is interesting to note that some growers have reported very favourably on King George as a first early, and claim that, if boxed and sprouted and planted at the same time as Epicure, it gives a large crop of potatoes of good quality equally as early. Usually, however, King George is grown as a second early, and should be lifted, as a general rule, not later than the end of August.

Main crop varieties are always changing, but of late years King Edward has been a great favourite at most markets in England, though unfortunately this variety does not seem to possess enough vigour to grow a really heavy crop, except under favourable soil conditions and with a fairly heavy rainfall. Arran Chief is a very good potato, giving a good yield on nearly all soils, even in a dry season. Unfortunately neither of these varieties is immune from wart disease, which has become so prevalent during the last year or two, and growers are turning their attention to several of the new immune varieties. These are too numerous to mention in detail, but Great Scot and The Ally have proved very vigorous potatoes, giving big yields of good quality tubers. Kerr's Pink is also being grown to some extent, and has given some very heavy yields. Majestic, although a heavy cropper, is inclined to be coarse.

Spraying.—Although the practice of spraying potatoes is getting more popular, very few farmers realise that, apart from preventing potato disease, spraying increases the crop very considerably by extending the growing period.

Spraying should be carried out at least twice in the season. The best times for spraying vary in different parts of the country, but, speaking generally, the first spraying should take place during the first fortnight in July, and the second about three weeks later. In a wet season it may be necessary to give a third spraying.

Two types of horse-drawn spraying machines are in use—one for dry spraying and another for wet spraying.

It is claimed that the application of liquid spray (either Bordeaux or Burgundy mixture) is more effective than a dry spraying, but the writer has always used dry spray and found it very effective. Dry spraying should be done late at night or early morning, when the dew is on the leaf.

Harvesting.—If the ground is very hard and dry, the best way to lift potatoes is by means of a potato plough. By this method the tubers are not bruised, but care must be taken to have the share of the plough well below the potatoes.

If the ground is reasonably soft, the method of using a potato digger is preferable. The digger must not be driven too fast, otherwise the potatoes will be thrown too far, thereby making extra work for the pickers, and to use a screen damages the potatoes. In this case also, care should be taken to have the broadshare of the digger an inch or so below the lowest tubers. If this is not done, the result will be a lot of split and damaged potatoes. All damaged tubers should be taken out when dressing for market, as the market prices naturally depend largely upon well dressed samples.

Probably the cheapest method of picking potatoes is as follows. If the crop is good, nine pickers will be required on each side, but if very heavy, ten will be necessary—in other words, eighteen or twenty pickers respectively. The length of ridges should be measured and divided into ninths or tenths as the case may be, and stakes should be inserted in the middle of the work, so that each picker will have his or her equal share. Then each picker should be supplied with five bushel or potato baskets, and three carts should follow round at regular intervals, the potatoes being emptied into the carts and taken loose to the clamp.

Clamping.—This is work that requires careful attention. The bottom of the clamp should be about four feet wide and not more than from three to four inches deep. The side of a potato clamp should be made as steep as possible, and the clamp brought to a sharp point at the top. As the clamp is formed it should be covered with dry wheat straw, well straightened out, and packed tightly about six inches deep. The clamp should be earthed up at once if possible—while the straw is dry. If this is done, with about seven inches of earth, there will be little risk from frost, always taking care that the trench outside the clamp is about six inches deeper than the bottom of the potato clamp in order that the potatoes will lie quite dry. It is essential when earthing up the clamp to place a straw ventilation on the top, at least every six feet. This will let any heat out of the clamp and the potatoes will keep very much better.

THE INFLUENCE OF SIZE AND CHARACTER OF SEED ON THE YIELD OF POTATOES.

REDCLIFFE N. SALAMAN, M.A., M.D.

IN 1920 a preliminary investigation of the above problem was begun. For this purpose a stock of a new variety* was employed, which had been grown in Barley, Herts, the previous year; the tubers had been clamped during the winter and sprouted in the spring. This main crop variety is well adapted to this type of experiment for two reasons: it is an exceptionally heavy cropper and it is extremely resistant to leaf-roll and mosaic. The tubers are white kidneys, and are immune to wart disease. This stock was raised in 1911 by the writer in Barley.

Selections of the seed tubers were made by the writer according to various grades, and the number of tubers in every pound weight of seed was carefully checked. The tubers were selected both for size and weight so that each class was as uniform as possible.

The classes selected were :—

	Weight of tuber sets.	
1.	0·4 oz.	i.e., 36 tubers to 1 lb.
2.	1·3 „	„ 12 „ „ „
3.	2·0 „	„ 8 „ „ „
4.	2·6 „	„ 6 „ „ „
5.	4· „	„ 4 „ „ „
6.	5·3 „	„ 3 „ „ „
7.	5·6 „	„ 12 „ „ $4\frac{1}{4}$ lb.
8.	6·0 „	„ 12 „ „ $4\frac{1}{2}$ „
9.	Mixed seed of all sizes.	

Class No. 8 was not chosen with the idea of differentiating the crop obtained from seed so very similar, both in size and weight, to those used in Classes 6 and 7, but to discover whether seed tubers which carried much secondary growth influenced the resulting yield. In fact Class 8 differs merely as to the presence of secondary growth on all the seed tubers used, from Classes 6 and 7. The tubers were planted in rows in the midst of a farm crop of potatoes of the same variety. The part of the field selected, the soil of which is a medium clayey loam, is as nearly uniform in quality as it is possible to find in this part of the country, and was chosen for that reason. Manuring was the same for the entire potato crop, viz., 15 tons per acre laid in the furrows on which the potatoes were planted. The

* This potato is not, as yet, on the market.

distance between the sets was 15 in. and between rows 30 in. Tubers were not cut.

It is realised that in order to obtain reliable and accurate results in respect to cropping, it is rightly accepted that each plot should be repeated several times and the probable error calculated; this has not been done. Notwithstanding, there is evidence that a very considerable degree of accuracy may be ascribed to the results obtained. Thus when the ware sized tubers were used as seed, Classes 5-7, the resulting crops are 12.0, 11.2, 11.8 tons per acre respectively, which is not only a closely similar result, but one which previous experience would suggest. The very striking similarity between the average of the analysed results of the eight crops with that derived from mixed unselected seed of the same variety (Table II), would further suggest that the crops as shown in each of the eight classes cannot vary much from their true modes. Without therefore, wishing to stress unduly the results arrived at, the writer feels considerable confidence that the outstanding features which will be shortly detailed may be accepted as a general guide to the solution of the problem in hand.

In Table I the actual weight and number of seed of each of the eight classes employed are shown. In addition the weight of the crop returned; the ratio of yield to seed weight; the yield per acre; the weight of seed used per acre; the weight of ware tubers of 4 oz. weight and over, and the net crop after deducting the weight of seed used are shown.

TABLE I.

	Class of Seed Tuber.	Weight of Set	Weight of Seed Used.	Number of Sets.	Weight of Yield.	Ratio Seed to Yield.	Yield per Set.	Yield per Acre.	Weight of Seed per Acre.	Ware per Acre 4 oz. and over	Yield per Acre less Seed.
		oz.	lb.		lb.		lb.	tons	tons	tons	tons
1.	36 : 1 lb.	·44	8·5	304	280	1 : 33	·92	5 7	·17	2·15	5·53
2.	12 : 1 lb. ..	1·33	29	348	504	1 : 17·4	1·45	9·0	·51	2·45	8·49
3.	12 : 1½ lb. ...	2	31	248	553	1 : 18	2·23	13·8	·77	4·36	13·0
4.	12 : 2 lb. ..	2·66	73	438	756	1 : 10·3	1·73	10 7	1·	3·67	9·7
5.	12 : 3 lb .	4·	16·5	66	128	1 : 7·8	1·95	12·0	1·5	2·64	10·5
6.	12 : 4 lb. ...	5·33	47 5	142	256	1 : 5 4	1·8	11·2	2·1	3·55	9·1
7.	12 : 4¼ lb. ..	5·66	50	141	264	1 : 5·3	1·9	11·8	2·2	2·82	9·6
8.	12 : 4½ lb. Secondary growths	6·	20	53	123	1 : 6·1	2·35	14·6	2·4	3·8	12·2

From this table two facts are evident :—(1) That it is tubers of 2 oz. weight which give the best return of crop, excepting the large tuber sets with secondary growths. When, however, the

weight of seed is taken into consideration with the yield, then the crop from the 2 oz. set is the heaviest of all. (2) That the crop from the sets with secondary growth is very much greater than any of the others, which is a fact of considerable interest. It is hoped that experiments will be continued to ascertain whether such tuber sets, cut into pieces of 2 oz. weight, would yield equally good crops. If such is the case, as is very probable, then there would be great advantage in using such, especially in view of the fact, as we shall see later, that the tendency to secondary growth is in no way conveyed by the tuber.

That the sets with secondary growths should have proved such successful seed is, however, not surprising; a secondary outgrowth indicates a high vegetative activity on the part of the parent tuber, and the outgrowth itself is in the nature of an immature tuber, which experience has long shown to be the best type of tuber seed.

Samples taken at random from the crops derived from the eight classes were analysed into the following groups of tubers :—

Class *a*.—Tubers under 1 oz. in weight.
„ *b*.— „ of 1–1¼ oz.
„ *c*.— „ „ 1½–2·6 oz.
„ *d*.— „ „ 3–4½ „
„ *e*.— „ „ 5 oz. and upwards.

The results are set out in Table II.

TABLE II.

	Seed Class.	Weight of Sample.	Percentage of Total in each Crop Class. *a*.	*b*.	*c*.	*d*.	*e*.	Heavy Ware *d*. and *e*. combined
		lb.						
1.	Under 1 oz.	32	4·0	5·0	18·0	37·0	36·0	73·0
2.	1·33 oz.	30·5	5·4	9·7	29·5	19·6	35·0	54·6
3.	2 oz.	29·25	3·45	2·55	30·7	24·0	39·2	63·2
4.	2·66 oz.	30	5·8	2·33	23·3	26·6	41·7	68·3
5.	4 oz.	29·35	9·4	8·9	37·5	20·5	23·9	44·4
6.	5·33 oz.	30	5·0	8·6	28·3	18·3	40·0	58·3
7.	5·66 oz.	30·5	4·92	10·6	36·0	23·3	24·5	47·8
8.	6 oz. with outgrowths	36·5	5·45	8·2	34·3	24·5	27·5	52·0
	Average of 8 classes	31·0	5·43	7·22	29·7	24·2	33·6	57·8
9.	Mixed seed	27·6	4·55	4·93	25·6	32·5	32·5	65·0

The percentages of weights of each group in each sample varied within relatively small limits from each other, or from the control sample derived from mixed seed of the same variety.

The crop from the small chat tubers produced a greater percentage of large ware than those from the heavy seed.

As the value of a potato crop is concentrated in the main on the quantity of the large ware size tubers formed, it is of interest to refer to the last column in Table II where the percentage of the entire crop represented by the tuber of 4 oz. and over is shown. The highest value, viz., 73 per cent. of the total crop is given by seed tubers of less than 1 oz. in weight, *i.e.*, by chats, so that it would appear the larger the set the smaller the quantity of big ware. When, however, the fact is taken into account of the bigger crop thrown by the 2 oz. sets the total yield per acre of large ware is considerably greater in this than in any other class. If, however, cut tubers with secondary growth will yield in the same manner as the large ones of Class 8, then the advantage of such sets might at least equal that of the 2 oz. set in the production of heavy ware.

A further analysis was made of the crops from the 8 different sized sets, as well as one from mixed sets in respect to the number of tubers in each weight group. Table III shows the result as well as the weight of the sample, and the total number of tubers contained in it.

TABLE III

				Percentage of Number of Tubers in each Class of Yield.				
	Seed Class.	Weight of Sample.	No of Tubers in Sample.	Under 1 oz.	1-1¼ oz.	1½-2·6 oz	3-4½ oz	5 oz. and over
		lb.						
1.	0·44 oz.	32·12	156	12·8	15·4	24·3	30·7	16·7
2	1·33 oz	30·5	204	24·5	19·6	31·0	11·8	13·3
3.	2·0 oz	29·25	159	14·5	7·55	43·5	17·6	17·0
4.	2 66 oz.	30	160	25·0	6·9	28·8	20·0	18·8
5.	4·0 oz.	29·35	207	28·8	16·9	34·8	11·2	8·2
6.	5 33 oz.	30	166	19·3	15·7	35·5	13·2	16·3
7.	5·66 oz	30·5	205	18·5	21·5	37·0	13·7	9·3
8	6 oz with outgrowths	36 5	263	23·5	18·3	34·3	13·7	9·6
	Average of 8 Classes	31	190	20·8	15 2	34·3	16·5	13·7
9.	Mixed Seed	27·6	154	19·5	11·6	30·5	23·5	15·0

It does not appear that any inference can be drawn from these figures, except that small sets do not tend to produce any undue proportion of their like, nor large sets of theirs. There is far less conformity between the numbers of tubers in the same groups of the yields from each of the 8 crops than there was in the case of the corresponding weights of the tubers. This

result is in harmony with a long series of unpublished experiments, which, amongst other things, show that the crop of a potato plant must be expressed in the quantity of tuber material produced, its subdivision into tubers depends on other factors and is probably influenced by environment. The general approximation of the numbers of tubers in the classes of the crop from mixed seed, with that of the average of the eight seed classes, is a fact of considerable interest.

It will be remembered that seed class No. 8 consisted of large tubers with secondary growths. A close scrutiny was made throughout the crops of the 8 classes for tubers exhibiting any tendency to similar outgrowths. In Table IV the percentage of tubers thus affected in each class is shown. It will be noted that so far from the crop of seed class No. 8 showing any excess, it actually has by far the least of such tubers. It is, moreover, the bigger tubers in each case which tend to exhibit secondary growth at all. That the tendency to secondary growth formation should not be conveyed is in full accord with a number of more critical experiments the results of which will shortly be published by the writer and Mr. J. W. Lesley.

TABLE IV.

	Seed Class.	Percentages of Secondary Growth in each class of Tuber.				
		Under 1 oz.	1-1½ oz	1½–2·6 oz.	3-4½ oz.	5 oz. and over
1.	0·44 oz. ...	0	8·6	0	10 2	15·4
2	1·33 oz. ...	2	5	4·75	16 35	33 3
3.	2·0 oz.	0	0	8·7	28·5	37·0
4.	2·66 oz.	2·5	0	4·35	6·25	23·5
5.	4·0 oz.	0	2·85	1·4	8·3	35·2
6.	5·33 oz. ...	0	3·55	5·1	0	33·3
7.	5·66 oz. ...	0	0	3·95	14·3	21·0
8.	6 oz. with outgrowths..	0	0	0	2 75	8·0
	Average	·5	2·5	3·53	10 83	25 8
9.	Mixed Seed ...	0	0	15·0	13·9	43·5

It will be seen also, that there is no relation between the amount of tubers with outgrowths in the same weight groups in the crops from the different seed classes, excepting that in the small weight classes the proportion is uniformly low, whilst in the higher ones it is very variable, but generally high. There is here no such close relation between the values for the average of the crops from the eight seed classes, and those of the groups in the crop from the mixed seed as was found in respect of both

weights and numbers of tubers—see Tables II and III. It appears that neither size, weight, nor external character of a tuber set, influences the phenomenon of secondary outgrowths in the potato crop.

Although the tendency to produce secondary growth is obviously not carried on by the tuber seed, nor influenced in any way by the size of the set, it is, however, clearly a property of larger, rather than smaller tubers of the crop.

The results of the experiment so far as this first year allows of conclusions are :—

1. That although small chats give a great return in proportion to their weight as seed, and produce as much, in this experiment more, big ware as any class of seed, yet they are decidedly uneconomical.

2. The best seed class are tubers of 2 oz. in weight.

3. Seed tubers over 2 oz. in weight give smaller crops whilst the amount of seed used is progressively greater. The amount of heavy ware is progressively less both actually and relatively.

4. The tendency to secondary growth formation is not conveyed to the crop from the seed tuber. It is a peculiarity of big tubers and is not directly influenced by the size of the seed tuber.

5. Seed tubers with secondary growth make exceedingly good seed, and, apart from the fact that they are large and wasteful without cutting, the evidence would tend to show that their use as seed is strongly indicated.

In conclusion it may be noted that the experimental results as regards the best weight of tuber sets being 2 oz. merely confirms general experience. As to the value of tubers exhibiting secondary growth as seed, it is the custom amongst the allotment holders and others in this district to use, when cut as seed, those tubers they exhibited in the local Flower Show for " largest size " class, and which almost invariably are deformed by prominent outgrowths, in the firm belief that they yield the biggest crops and earliest crops of the particular variety.

COMMON SCAB OF POTATOES.

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EVERY farmer and gardener knows the uncertainty with which, despite every precaution, he looks forward to the harvesting of a sound potato crop. So many are the fungoid diseases which attack the potato that it often seems barely possible for the plants to escape infection from one or more of them. It is true, that, in the case of some of the worst diseases, certain protective measures may be taken which give a fair guarantee of immunity, but in the case of many others, which, though perhaps less generally destructive, are often very serious, escape from attack is very much a matter of luck with the majority of growers.

Two of the most harmful diseases which come into this category are Corky and Common Scab. Both are widely distributed, to a large degree seasonal in their outbreaks, and each is frequently responsible for great loss in many potato crops, which, before lifting, appeared free from disease.

A certain amount of experimental work has already been carried out on Corky Scab, and the results of this together with the treatment recommended are embodied in Leaflet No. 232. A detailed description of the two diseases, which bear a certain superficial resemblance to each other is given in the same leaflet.

In the case of Common Scab, little information has been available, and no treatment could be recommended with any certainty of success. An investigation of the disease, extending over a number of years has, therefore, been carried out at the University of Leeds, and it is hoped that the results obtained may be of service to those growers, who up to the present have been practically at its mercy.

A report[1] of the experiments has been recently published by the University of Leeds and the Yorkshire Council for Agricultural Education, and the present article is therefore intended to give a short account only of the disease with especial reference to the remedial measures found effective for it.

Common Scab is found in its most virulent form on light sandy or sharp gravelly soils, and a photograph of the disease as it occurs on such soils is given herewith (Fig. 1); it appears to a lesser extent on heavier soils and is practically unknown on peat soil. It is frequently associated with the presence of ashes in the soil.

On these grounds, the idea arose that Scabbing was due to the wounds inflicted on the swelling tubers by sharp soil particles with which they came into contact during their growth, and the disease was thus long known as "Mechanical Scab."

In America, however, so long ago as 1890, the work of Thaxter[2] had shown that Common Scab—or Deep Scab, as he then called it—was due to the attack of a fungoid organism now known as Actinomyces scabies (Thaxter) Güssow. Although during recent years it had been assumed that English and American Scab were identical, Thaxter's work had never been confirmed in this country, and certain text books, still in common use even averred that "American Scab," *i.e.*, that produced by Thaxter's organism, was almost unknown here. Pethybridge, however, carried out experiments in Ireland in 1914 and came to the conclusion that there could be practically no doubt that Scab was due to an organism.[3]

It thus appeared very necessary to repeat the American work for Common Scab as we know it in England, and this has formed one section of the Leeds investigation. The details of the work are not included in the Report above mentioned, but it is hoped they will be published shortly.

The results showed *Actinomyces scabies* to be the cause of Common Scab, and thus proved the American and English diseases to be one and the same. From other experiments, it was also shown that Scab was not produced by mechanical injury from sharp soil particles and, with the combination of these results, the problem of controlling the disease reduced itself to the simpler one of fighting a fungoid pest, whose characteristics could be studied at will in the laboratory.

Remedial Measures.—The discovery of a remedy for the disease formed the second section of the investigation. Experiments in America on the prevention of Scab appear to have consisted mainly of attempts to sterilise the soil by means of fungicides such as copper sulphate, corrosive sublimate, &c. but, these have not given any results of practical value. Sulphur has also been tried by various investigators but with indifferent success.

The only previous English work on the subject is that of Seton and Stewart,[4] who carried out a series of experiments at the University of Leeds in the years 1904-7 and came to the conclusion that "whatever the cause of Scab may be, it would seem that there is some relationship between the virulence of the disease and the moisture holding capacity of the soil."

Fig. 1.- Common Scab of Potatoes

Green-manured Untreated.

FIG. 2 —The effect of Green manuring on Scab. Experiment in 1919.

Later, Professor Seton conceived the idea of increasing the moisture holding capacity of the soil by green-manuring, and the present series of experiments is the natural outcome of this suggestion. Subsequent experiments have shown that the hypothesis put forward could not be maintained, but the treatment to which it gave rise, has, for some other reason which will be discussed later, given excellent results.

The first experiment in which it was put to the test was carried out in 1914 as follows:—

Two plots, No. 1 and 2, were selected on soil known to produce Scab. On Plot 1 a quantity of fresh grass lawn mowings was spread at the rate of 30 tons to the acre, and when this had withered somewhat, it was forked in. No dung was used but a mixture of artificials was applied to each plot.

Two-thirds of each plot was then planted with clean "sets" and the remaining third with badly scabbed "sets" of "Dalhousie" potatoes. The plots were then cultivated in the usual way.

When harvesting, a great contrast was shown between the respective crops. That from Plot 1, both from the clean and scabbed "sets" was almost entirely free from Scab and the skin of the tubers showed the smooth glossy appearance rarely seen except on Potatoes raised on peaty soil.

That from Plot 2 was badly scabbed as usual, the tubers from the scabbed "sets" being slightly worse in this respect than those from the clean.

The respective yields from the two plots and from the different parts of the same plot were as follows:—

	From Clean "sets." Per acre.		From Scabbed "sets." Per acre.	
	tons	cwt.	tons	cwt.
Plot 1, Green Manured ...	18	5	10	15
Plot 2, untreated	12	10	8	0

In addition therefore to the main object of the experiment, it is clear that grass provides an excellent manure for the potato crop and materially increases the yield. It should also be noted that the yield given by the scabbed seed fell considerably lower than that from the clean seed on both plots and on these grounds, the use of clean seed is to be advocated.* Scab on the seed does not, however, appear to have much effect on the amount of Scab

* The scabbed seed was from the same sample as that shown in Figure 1 but was not obtained from the same source as the clean seed. It is apparently only where the scab has attacked the eyes of the tubers, that the yield is affected so adversely by it.

produced in the crop. This experiment with slight variations in the amount of grass applied, and in the manner in which it was introduced into the soil, was repeated on the same plots in 1915, 1917 and 1919 and on some other plots in addition in 1915 and 1919. In every case similar results were obtained.

The dry year of 1919 was the worst season for Common Scab known in Yorkshire for some time past and the photograph of that year's results is thus selected for reproduction here (Fig. 2). In the Report mentioned, however, photographs of the four years' results are given.

Conclusion.—There appears to be no doubt that the introduction of green organic matter into the soil may be regarded as a means of securing a clean crop. The amount necessary to secure the best result will naturally depend on the scab producing propensity of the soil. Very good results have been obtained with 10 tons to the acre of fresh material on soil where the control plot gave a badly scabbed crop.

In estimating the quantity to apply, it should be remembered that green plants contain approximately 75 per cent. water and thus the amount of half dry or withered grass required will be considerably less than that of fresh material. No trials have been made with hay but there seems no reason to suppose that this would not act in the same beneficial manner. The secret of success appears to lie in securing such an intimate admixture of the vegetable matter with the soil that the young potatoes form in a compost consisting largely of the decaying organic matter. On a small scale, where the land is cultivated by hand, this is not a difficult condition to secure. The grass may be applied in different ways. It may be spread on the surface and forked in before planting or. a part may be strewn in the trenches at planting time, a further portion added with the soil in filling in the trenches and the remainder strewn lightly over the surface and worked into the soil on earthing up.

On a larger scale. where green manuring can only be carried out by ploughing in a green crop growing on the soil, it is difficult as yet to suggest by what method it would be possible to secure an intimate incorporation of the green crop with the top spit of soil. and at the same time to allow of subsequent cultivations. It is not too much to hope, however, that the ingenuity of the practical agriculturist will find some way in which this difficulty may be overcome and the treatment applied.

In the experiments recorded in the Report, grass was the only vegetable substance tested. In another experiment, good

results were obtained by digging in a crop of Rye and planting the potatoes soon after the operation. There appears to be no reason, however, why other sources of organic matter of vegetable origin should not be used with equally good effect. Leaf mould is used by some gardeners with good results, and since carrying out this work the writer has been informed that spent hops are employed in some localities for the same purpose.

How Grass Inhibits Scab.—Various theories were formulated during the course of the investigation to account for the prevention of Scab by grass and plant residues, and this part of the work proved far the most difficult. Experiments on it were carried out concurrently with the repetition trials of the treatment, but, for a full account, the reader must be referred to the Departmental Report. The conclusion there drawn is that the fungoid organisms responsible for the Common Scab are primarily saprophytic, that is to say, they feed on dead organic matter in the soil, where they thrive mainly on plant residues and aid in the early stages of its decomposition. Only when these natural supplies of food are exhausted do they become parasitic on the potato tubers.

It is not difficult to see that this deduction will account for many of the observations made in regard to Common Scab. Two of those made earlier in this article may be recalled. Scab is most prevalent on light sandy or gravelly soils and is practically unknown on peat soils. In soils of the first type, especially where these have been liberally supplied with lime, organic remains tend to disappear rapidly and the scab organisms being left with a deficiency of food, attack the potato. The introduction of fresh supplies of plant residues remedies this defect, and may be considered to act as a decoy for the fungus. The potato crop in this way escapes attack. In a peat soil, however, large reserves of organic matter are present naturally, and there is consequently no fear of the crop being attacked.

Other phenomena relating to Scab, in particular the influence of lime and ashes on the disease, may be accounted for in a similar way. More work is being carried out on the subject, and it is hoped to publish a further report of the experiments in due course.

(1) "*Common Scab of Potatoes*," *University of Leeds and Yorkshire Council for Agricultural Education*, Report 118.

(2) *Connecticut Agric. Expt. Station*, Report for 1890.

(3) *Investigations on Potato Diseases*, 6th Report, *Journ. Dept. of Agric. and Tech. Instruction for Ireland*, Vol. XV., pp. 491–526.

(4) *University of Leeds and Yorkshire Council for Agricultural Education*, Reports 55, 63, 70.

DUCKS AS EGG-PRODUCERS.

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WITH the high cost of labour and the general depreciation in the saleable value of their principal products, farmers are finding it increasingly necessary to look around for every possible source of income, and to concentrate on those branches of the farm which require the minimum of labour. In these circumstances it is thought that farmers and all occupiers of grass or orchard land might profitably consider the possibilities of ducks as egg producers. With proper management the labour expenses are small and the returns are regular. There is likely to be an increased demand for well bred stock birds of the best laying strains, and duck egg production can be easily made the source of a regular weekly income.

Considerable advance has been made lately in the science and practice of egg production. Many farmers, realising the increased economic value of poultry, now recognise them as a distinct branch of the farm, and give proper attention to their management. This advance, however, has been made with one section only, for whilst hens have received greatly increased attention, ducks have been neglected. It is not suggested that ducks should in any way replace hens, but that both can be kept so long as separate sleeping accommodation is provided.

Swimming water is not necessary; in some circumstances it may be a disadvantage: the best laying breeds lay quite as well without it, and their eggs are as fertile. The general dislike of the strong, green duck egg is sometimes quoted as an objection to ducks as egg producers; this is immaterial, as well bred ducks of suitable breeds lay pearly white eggs which have a ready sale. There is also a doubt whether the market can absorb a large number of duck eggs; this remains to be proved, but at present there appears to be no reason for anticipating a greater difficulty in disposing of the fresh, clean, white duck egg than of the hen egg. There will of course be seasonal gluts just as with hen eggs.

Advantages of Ducks as Egg-producers.

Management.—Ducks require less attention than hens: feeding is less frequent and more simple. This is especially the case where grass range is available.

Housing.—There is no need for an expensive house or scratching shed. If a house is provided it can be of the simplest

kind and very cheaply made. Glass windows, perches and nest boxes are not required, and although bedding is necessary if a duck-house is used, there are no expenses in purchasing scratching litter.

The writer prefers leaving the ducks absolutely in the open as soon as they are large enough to be safe from rats.

Feeding.—Feeding is less frequent than with hens. A wet mash given late in the day is the essential meal, and only simple ingredients like ground oats, bran and fishmeal are necessary. Hard corn is only required if the ducks have not free range or if their eggs are to be used for incubation. Variety, which a duck does not appear to relish, hinders rather than helps egg production.

Fencing.—The fencing, which is very expensive for poultry runs, costs much less in the case of ducks, as wire netting 3 ft. or 4 ft. high will keep most kinds within bounds.

Depreciation.—Whilst hens are rarely worth keeping after their second season except for breeding purposes, and are less productive in their second season than in their first, well bred ducks often lay as well in their second as in their first season, and are usually profitable in their third and sometimes in their fourth. Being also less subject to infectious diseases, and generally more healthy, they are less likely to die young than hens, so that replacement charges are less.

Laying Capacity.—The writer does not wish to support the extravagant claims of egg laying which are sometimes made on behalf of ducks, as there have been very few real tests of comparison between hens and ducks. He is of opinion that pullets and ducklets of the best laying breeds average about the same number of eggs per bird per year, but that the best ducklets will probably produce more than the best pullets. Second, third and fourth season ducks undoubtedly average more than hens of the same age.

Size of Eggs.—Practically all duck eggs are large, being well over the 2 oz. standard.

Consistent Laying.—Well bred ducks often lay continuously for very long periods.

Good Autumn Production.—Ducks lay a large proportion of their eggs when prices are high; if properly managed, their production after the moult in the autumn may be quite as good as in the spring. The writer's best records with Khaki Campbells were made in the autumn by second season ducks after their moult.

Foraging Capabilities.—Given a good range, ducks will travel far and wide and pick up a large proportion of their food.

Small Liability to Disease.—Ducks are more healthy and at the present time less subject to disease than hens. They seem to be more or less immune from most of the commoner fowl ailments.

Hardiness.—Ducks are less affected by rain, snow and frost than hens, so that they can profitably sleep out of doors.

Damage to Crops.—Ducks do much less damage to farm and orchard crops than hens, as they are unable to scratch with their webbed feet and their bills are too blunt to do much damage by pecking. They are of great value in orchards for destroying insect pests.

General Remarks.—On partly arable farms ducks are a source of income which is helped by the wet unsettled weather which so often damages arable crops in this country in summer time. Nearly all duck eggs are laid early in the morning before about 9.30 a.m. This simplifies gathering and makes individual recording much easier. The colour of the egg shell of the best strains of ducks is a pearly white. These eggs find a ready market and usually make about the same price as hen eggs: sometimes in the spring they command a little more. The green duck egg, however, is less easily marketed, especially in summer time, and should be eliminated. The flavour of duck eggs from the best laying breeds is not strong unless unsuitable feeding is allowed. They are like large white hen eggs except that the shell is rather more pearly white and the membrane lining is slightly thicker and stronger.

Disadvantages of Ducks as Egg-producers.

(1) Ducks are more nervous then hens, and easily harassed. Handling or any change of feeding or treatment are liable to disturb them, with consequent loss of eggs. Moulting out of season is also more liable to occur in ducks.

(2) Duck houses are more difficult to keep clean than hen houses.

(3) When ducks are so disturbed that they cease laying, it is sometimes very difficult to get them to commence to lay again.

(4) Ducks are not so suitable for the back garden as hens. They lay well in confined runs, but the ground is difficult to keep clean and the amount of food required is much greater than when the birds have free range. They are also more likely to disturb neighbouring households by their quacking.

The Best Laying Breeds of Ducks.—There are very few first class laying breeds, but it is probable that the increased interest taken in ducks will soon lead to the production of several new ones. Fawn and White and White Indian Runners, Khaki Campbells and Buff Orpingtons are the best and the most popular at present. The entries in the Stapleford Duck Test, and in the Test which the National Utility Poultry Society and the Utility Duck Club are carrying out in conjunction with the Great Eastern Railway Company at Bentley. seem to show that White and Fawn and White Indian Runners have been considered the best layers and are, therefore, much the most widely distributed. The final results at Stapleford, however, and the early reports of the Test at Bentley, show that Khaki Campbells are making a strong bid for the premier position. It is probable, therefore, that this breed in particular will meet with an increased demand in the near future.

Indian Runners, Fawn and White or White, have a very upright carriage, and clean, well marked flocks are very attractive. They are good layers of white eggs, but being very small birds are not of high value for table purposes, though if killed when 9 or 10 weeks old they make excellent eating. Birds of the best strains are very good layers; some strains have been rather spoilt because a few breeders have given too much attention to their show points, and have practised too close breeding. Indian Runners, especially the white variety, are liable to look very dirty and disreputable in muddy situations unless they have clean swimming water.

Khaki Campbells are larger and less upright in carriage than Indian Runners. Owing to recent crossing with the wild duck they are considered hardier birds, and more suitable for an open air life. The colour more or less resembles mud, and in wet weather it has not the dirty appearance of the white duck; they are, therefore, a more suitable breed for muddy situations and where there is no swimming water or only limited accommodation. They average about a pound heavier than Runner ducks, are better table birds, and are equally as good and possibly better layers of white eggs. They have been exhibited very seldom and are bred principally for egg production. The best strains of Indian Runners and Khaki Campbells are about equally good as egg producers, but there appears to be a smaller proportion of poor layers among the Khaki Campbells.

Buff Orpingtons are also good layers, but on the average it is probable they are not quite so good as Indian Runners and

Khaki Campbells. They cannot be considered first-class egg producers until the green egg, now all too frequent, has been eliminated entirely. This breed of duck is larger and heavier than either of the above-mentioned birds and serves the dual purpose of egg production and table use.

Pedigree Breeding of Ducks.—Chiefly owing to the supposed difficulties of keeping individual records of production, very little pedigree breeding of ducks has been undertaken, except by a small number of specialist breeders. More attention is now being given to this branch of the subject and various methods of obtaining individual duck egg laying records have been evoked.

Type of Duck Required.—Primarily it is essential to obtain birds of a strain which has been developed for egg production by a skilful specialist breeder. The anatomical points of a good layer seem to be the same with ducks as with hens. The bird should be so built that plenty of room is available for the digestive and reproductive organs; breadth and depth of body, width across the back and between the legs are therefore desirable. Small boned active birds with sharp, snaky, fine looking heads and necks, seem to give the best results, especially those with bright prominent eyes set high up in the skull. The thick clumsy head and short thick neck are undesirable features. Large, coarse boned, heavy birds should be avoided.

Housing: Open-air Methods.—There is a great difference of opinion as to the best methods of housing ducks. The primary object is to keep them healthy, contented and productive as economically as possible. Few duck houses comply with these conditions. It is almost impossible to keep them clean without a large expenditure in labour and bedding material; the ducks rarely approve of being shut in at night, and if left alone will usually remain outside. Most authorities insist that a dry bed at night is essential for ducks; the writer, however, considers that the natural clothing of feathers in waterfowl is so arranged that their bodies remain dry and warm in wet surroundings. He prefers, therefore, to keep ducks without a house as soon as they are large enough to escape from rats. An open-air sleeping pen surrounded by wire netting, is provided instead of a house, and ducks kept in this manner appear to be more contented and less disturbed at night. In consequence, the air they breathe is fresher, they are hardier, healthier and better breeders. These open-air methods have proved extremely successful in the case of Khaki Campbells at Appleby, in North Lincolnshire. When severe wintry weather comes on, the egg

production of ducks which are housed at night, falls quite as much as those which are in the open all the time.

Feeding Ducks for Egg Production.—Ducks should be induced to obtain as much of their food as possible by foraging. Foraging is good for their health, increases egg production, and in consequence a smaller proportion of artificial food is required. It is most economical to feed, as far as it is possible, on home-grown and home-prepared foods. Fancy and proprietary laying meals are not recommended. The bulk of the food should be given in the form of a wet mash consisting principally of ground oats, wheat bran, and a reliable fish meal of low salt and oil content. If free range is available the only other necessities are some shell forming material such as cockle or oyster shell and drinking water. If the birds are confined in pens a small feed of heavy white oats or small wheat should be given in the morning and some vegetable food supplied. Flint grit is very seldom needed. Barley and barley meal are not recommended for egg production and maize is unnecessary.

Time of Feeding.—When free range is available, one feed of wet mash each day just before dusk seems to give the best results. It is a mistake to feed laying ducks in the morning or at mid-day except when foraging is for any reason either impossible or insufficiently productive. A morning feed removes the natural hunger, and the ducks no longer have any incentive to forage for themselves.

Amount of Food.—The weight required per bird per day, depends on so many factors, and is so extremely variable that it is unwise to give any figures. It will be found that the rate of laying, nature and extent of foraging range, warmth and moisture of atmosphere, and numerous other factors exercise a great influence on a duck's appetite and requirements.

It is a sound rule to give laying ducks on open range as much as they will eat when they return in the evening, but nothing at any other time of the day.

Training of Ducks.—Much depends on the way in which the young ducklets are trained. To give the best results it is essential that they should feel thoroughly at home and settled by the time they are old enough to commence production. They should, therefore, be taught when still young what to do and what treatment they must expect later on. The ducklets should be placed in their permanent laying quarters as soon as possible after they can be distinguished from the drakerels. They should then remain there, having the same sleeping accom-

modation and the same range for the rest of their lives, if the best egg returns are desired. Changes made at a later date are almost certain to result in a serious loss of eggs.

Immediately the ducklets have been put in their permanent laying quarters. they must be taught when and where to expect their food. They must be made to realise that they will not be given anything until just before dark. They must learn from experience that they can only obtain food by running about and looking for it, and that quacking has no effect on their attendant, who must be firm. It is wise to spend some time teaching ducklets where to forage. They should first be attracted from their permanent quarters by scattering a little corn on to their range in the direction in which it is desired they should go. They must not be allowed to remain in or around their sleeping quarters. If there are two or more flocks it is worth while trying to teach one to go in a particular direction and the other in the opposition direction. In this way a larger area of ground is covered and a bigger harvest of worms and insects is obtained.

Farm Duck Management.—Farmers and occupiers of grass land will find the following plan worthy of trial. It has proved very successful in the case of Khaki Campbells on a farm at Appleby in North Lincolnshire.

Two flocks of about twenty layers each may be kept at each farmyard or feeding centre. One flock should consist of ducklets and the other of second season ducks. The two flocks must be fed separately and must sleep separately. Two open-air sleeping pens should be arranged some distance apart, about 12 to 15 yd. square. They should be situated if possible in a quiet unused part of the farmyard where they will be safe from horses and cattle, and if possible they should be on thick-growing grass. Each pen should be surrounded with strong wire netting, hung on strong posts, the ends of which have been dipped in tar. In a fox country the wire should be 8 ft. high and let into the ground at the bottom; 6 ft. wire will be sufficient if there are no foxes. Fix a simple gate in the middle of the wire on whichever side of the sleeping pen is approached most conveniently from the food store. Place in the pen a sufficiently long feeding trough of simple make to enable all the birds to feed at the same time. Drinking water should be placed outside only, not inside the sleeping pen, and a liberal supply of cockle shell or other shell forming material should always be available. Arrangements should be made for a supply of about

twenty well bred April or May hatched ducklets. Preferably these should have been bred and reared on the same farm. If it is desired to stock a larger number of layers, each flock may consist of 25 to 30 layers, and 4, 6, 8, or more flocks may be undertaken. If it is decided to keep the ducks a third laying season, three sleeping pens should be provided instead of two, for each group of three flocks.

Anyone beginning in 1921 with the idea of keeping two small flocks would then proceed as follows:—

September 1,	1921.	20 ducklets (Flock A) put in Pen 1.
September 1,	1922.	20 ducklets (Flock B) put in Pen 2.
September 1,	1923.	20 ducklets (Flock C) put in Pen 1.
November,	1923.	Flock A sold out of Pen 1 when their autumn production of eggs ceases.
September 1,	1924.	20 ducklets (Flock 1) put in Pen 2 and Flock B sold in November.

Thus each season a new flock is introduced early in September to replace an old flock which is sold in November. Each flock is kept for two whole laying seasons and an extra autumn period. Two flocks inhabit one pen for two or three months each autumn until the older one is sold. If desired an extra sleeping pen may be provided, in which case the new flock goes into a clean empty pen, and the old flock is not disturbed by the appearance of the new one.

The following is the daily routine of work in connection with each flock:—

9.30 a.m. Open gate, count ducks out, collect eggs, shut gate. Towards dusk, open gate, put mash in trough, count ducks in, shut gate. See that cockle shell in abundance, and drinking water are available. At regular intervals clean the sleeping pens as thoroughly as it is possible and give them a good dressing of lime.

It is convenient to mix two or three weeks' supply of mash at one time so that it is only necessary at the time of feeding to wet sufficient for that meal. 12 to 15 per cent. by weight of the standard mash mixture should consist of good fishmeal, the bulk of the remainder can be ground oats with about 10 per cent. of bran. Other foods can be used but these are satisfactory, simple and are obtained easily. The attendant should also have a supply of fishmeal which may be used to encourage egg production if suitable care is taken. If the ducks are not laying sufficiently well, or if there is less natural food available than usual, a little more fishmeal should be added to the mash.

If the weather is warm and moist and there is an abundance of worms, or if the eggs are required for incubation, the amount of fishmeal should be reduced. If eggs are being freely produced in April and May in moist weather, it is a good plan to reduce the amount of fishmeal considerably, so that it is possible to increase it when the weather gets hotter and drier and less natural food is available. When the moult commences in July and August, fishmeal should not be given but introduced again as a strong incentive to egg production after the moult.

It is advisable to breed and rear at home the young ducklets which are to become a new laying flock in September. Four drakerels should be run with each flock of 20 ducks. Whole oats should be largely fed and less mash and fishmeal given as stock birds should not be forced. It is easier to hatch duck eggs under hens than incubators, and April and May are the best months for hatching laying ducks.

SIZE OF EGG IN RELATION TO AVERAGE PRODUCTION.

EDWARD BROWN, F.L.S.

COMPLAINTS have been made during recent years of the increasing number of home eggs below the recognised standard in size and weight which are placed upon the market. The advent of the commercial poultry farmer, whose main object is table egg production, and the increased practice of pedigree breeding for high fecundity may largely account for this decrease in the size of eggs, although farm eggs have also undergone a decrease, but in lesser degree. It is the general practice to use medium-sized or large eggs for table purposes, and to reserve the smaller ones for cooking or manufacturing purposes. Before the War large quantities of eggs were imported into this country, but these were mainly full sized, the "smalls" being retained for home consumption. The import trade has not yet regained its former dimensions, and home producers are not, therefore, faced with foreign competition to the same extent as formerly. It may be anticipated, however, that former conditions will gradually reassert themselves, and with the increased number of full-sized eggs which will find their way on the market, poultry keepers will be obliged to give closer attention to the question of the production of eggs of reasonable size.

Pullets of all breeds usually produce smaller eggs than do older birds, especially at the beginning of the laying period. This tendency is increased the earlier they commence to lay. Among the distinctive breeds there are great differences in the size of egg produced. The Minorca hen and Wyandotte hen are relatively about the same weight, yet the egg of the former is consistently larger than that of the latter. A similar difference is observed in the case of the smaller bodied types such as the Campine and Hamburgh; although both breeds are of the same ancestry, Campine eggs are larger than those of the Hamburgh. Many other instances could be given. A further point of importance is that the egg produced by improved races of poultry as the result of selection and better feeding is larger than that from the original stocks. The constant tendency to reversion can only be counteracted by careful breeding with a view to maintaining size of egg.

The influences which tend to the production of a greater number of small eggs may be briefly summarised:—

(1) When eggs are laid by pullets at a much earlier period than the normal, and before the body has attained maturity; such early laying checks the growth of the body, so that in process of time, in the absence of selective breeding, the size of the egg is reduced.

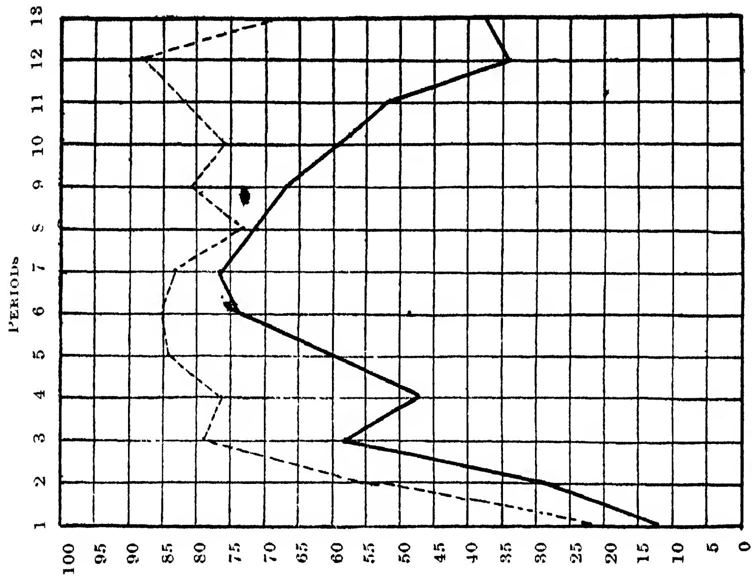
(2) When an increased number of eggs is laid within a given period there is a tendency towards reduction in weight; investigations and observations both in this country and America have shown that in a cycle of continuous laying each egg is slightly lighter than its predecessor, and that the maximum is not regained until a break in laying has taken place.

(3) There are periods when, in certain breeds, over entire flocks, a marked reduction in the size of egg takes place. The accompanying graphs illustrate this in the case of White Wyandottes, Leghorns, Rhode Island Reds and Plymouth Rocks. Periodical variations occur which differ according to breeds, but which, nevertheless, seem to follow a definite rule of variation within a breed.

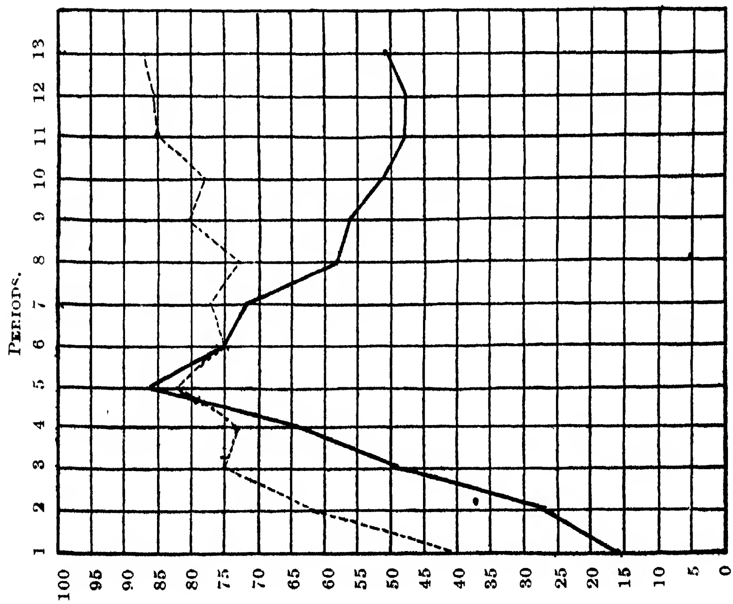
(4) The use of breeding stock before maturity has been reached; birds hatched from eggs smaller than the full size tend to smaller eggs.

At the Harper Adams Poultry Conference, held in August, 1920, it was advocated by some breeders that market standards for eggs should be reduced. There seems no reason, however, for any change from the present 2 oz. to 2¼ oz. standard.

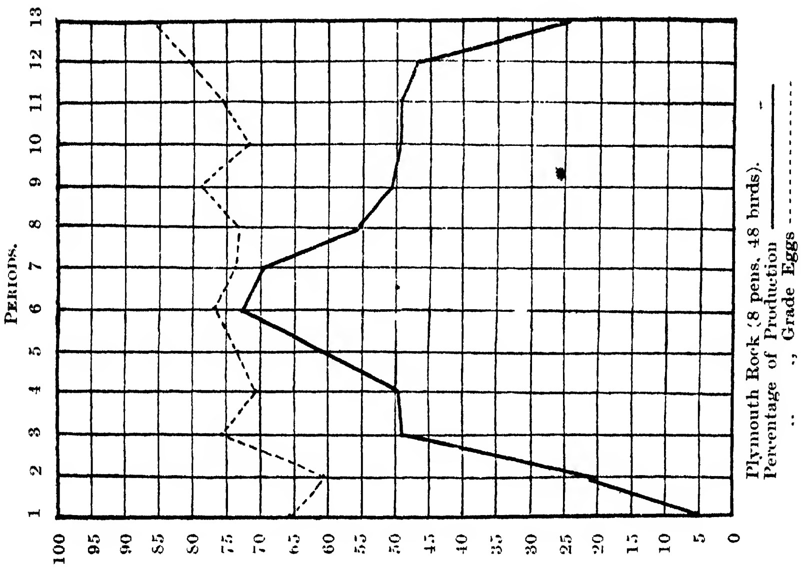
A study has been made of records presented in the Report of the 1918-19 Small Flocks Laying Trials at the Harper Adams Agricultural College, with a view to obtaining data as to (1) the relative proportion of undersized eggs to the total production; (2) the extent to which there was an increase in size during the whole year; (3) whether heavy winter laying has an appreciable influence upon the size of egg during the remaining periods of the year; and (4) the relation between total annual production and the size of the eggs laid. The breeds selected for observation were White Wyandottes (33 pens); White Leghorns (32 pens); Rhode Island Reds (8 pens); and Plymouth Rocks (8 pens). Each pen contained six pullets. These birds were carefully selected from much larger flocks, which had been bred with a view to early laying,



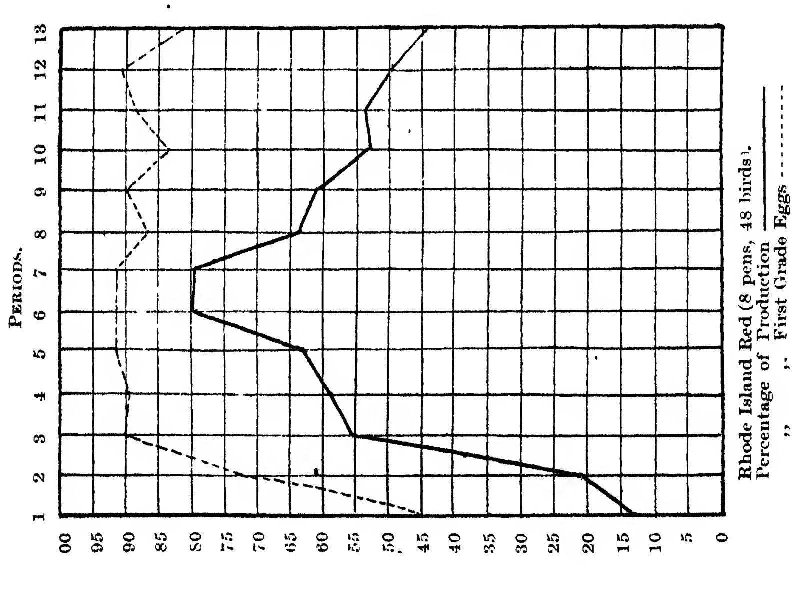
Leghorn (32 pens, 192 birds).
Percentage of Production ————
" " First Grade Eggs ---------



White Wyandotte (33 pens, 198 birds).
Percentage of Production ————
" " First Grade Eggs ---------



PERIODS.
Plymouth Rock (8 pens, 48 birds).
Percentage of Production
" " Grade Eggs



PERIODS.
Rhode Island Red (8 pens, 48 birds).
Percentage of Production
" " First Grade Eggs

and were from stock which had been reared for several generations for high numerical production. It was expected, therefore, that a tendency to lay small eggs would be noticed.

Table I gives the percentage of production in each period of four weeks. An egg per day per pullet is reckoned as 100 per cent. production, and an egg every alternate day 50 per cent. Table II shows the percentages of first grade eggs (2 oz. and over) and of second grade eggs (all eggs under 2 oz. during the first sixteen weeks and under 2 oz., but not less than $1\frac{3}{4}$ oz., thereafter).

TABLE I.—*Percentages of Production.*

	Periods.	*Wyandottes.*	*Leghorns.*	*R. I. Reds.*	*Plymouth Rocks.*
1.	Nov. 3—30 ...	16·4	12·9	12·4	5·2
2.	Dec. 1—28 ...	27·6	28·9	21·2	21·1
3.	Dec. 29—Jan. 25 ..	49·7	58·4	55·8	49·4
4.	Jan. 26—Feb. 22 ...	61·1	47·2	58·5	49·5
5.	Feb. 23—Mar 22 ..	86·7	60·9	62·9	61·0
6.	Mar. 23—Apl. 19	75·0	73·2	79·8	72·5
7.	Apl. 20—May 17	72·5	76·3	79·2	69·6
8.	May 18—Jun 14 .	58·8	71·3	63·8	55·7
9.	Jun. 15—Jul. 12 .	56·8	66·8	60·9	50·8
10.	Jul. 13—Aug. 9 ..	51·1	59·0	53·0	49·5
11.	Aug 10—Sep. 6 ...	48·7	51·9	53·2	49·8
12.	Sep. 7—Oct. 4 ...	48·7	34·4	49·2	46·4
13.	Oct. 5—Nov 2. ...	51·3	37·5	43·9	24·4

TABLE II.—*Percentages of First Grade* (A) *and Second Grade* (B) *Eggs.*

	Periods.	*Wyandottes.*		*Leghorns.*		*R. I. Reds.*		*Plymouth Rocks.*	
		A.	B.	A.	B.	A.	B.	A.	B.
1.	Nov 3—30 ...	41	59	22	88	45	55	66	34
2.	Dec 1—28 ...	62	38	57	43	72	28	61	39
3.	Dec. 29—Jan. 25 ..	75	25	79	21	90	10	75	25
4.	Jan. 26—Feb. 22 ..	73	25	77	23	90	10	71	29
5.	Feb. 23—Mar. 22 ...	82	18	84	16	91	9	73	27
6.	Mar. 23—Apl. 19 ...	75	24	85	13	91	9	77	23
7.	Apl. 20—May 17 .	77	23	83	17	91	9	73	27
8	May 18—Jun. 14 ...	73	27	73	27	86	14	73	27
9.	Jun. 15—Jul. 12 .	81	19	81	19	90	10	79	21
10.	Jul. 13—Aug. 9 ...	79	21	76	24	89	14	71	29
11.	Aug. 10—Sep. 6 ..	86	14	82	18	88	12	76	24
12.	Sep. 7—Oct. 4 ..	85	15	88	12	91	9	80	20
13.	Oct. 5—Nov. 2 ...	87	13	69	31	82	18	86	14

The accompanying graphs indicate the relation between size of egg and production in the thirteen periods of the year.

Selecting the 33 pens of Wyandottes for further study, remarkable variations are apparent in each period. The figures for these pens are given in Table III below. Two of the pens laid only second grade eggs during the first four weeks. In one pen the eggs steadily increased in size with the exception of two recessions, and in the last recorded period (the twelfth) produced 90 per cent. of first grade eggs; the other pen varied

to a much greater extent, and in the last period the birds laid only 26 per cent. of first grade eggs. A third pen, which in the first period produced 17 per cent. of second grade eggs, lost heavily, and in the fifth period had produced 64 per cent. of second grades; thereafter it slowly improved, and in the final month produced 78 per cent. of first grade eggs.

TABLE III.—*Relation of Size of Egg in the First Two Periods to Average Annual Production and Grade of Eggs (Wyandottes).*

Pen No.	*Percentage of 2nd Grade Eggs in first 56 days.*	*Yearly Average.*	*Yearly Percentage of 2nd Grade Eggs.*
33	28·6	201	33·2
34	53·7	220	30·0
35	57·6	191	39·0
36	56·6	231	39·5
37	No eggs laid	179	6·9
38	38·5	161	13·8
39	54·0	209	13·8
40	83·3	170	11·6
41	67·8	208	11·6
42	11·3	187	8·9
43	80·0	195	35·2
44	66·7	206	28·7
45	63·5	235	51·5
46	52·0	183	23·2
47	51·8	176	20·5
48	40·0	181	17·4
49	No eggs laid	151	10·4
50	49·2	217	19·6
51	15·9	194	12·9
52	30·6	158	6·8
53	11·8	185	12·3
54	76·5	184	16 5
55	22·8	173	15·6
56	44·0	217	20·9
57	50·0	204	28 5
58	69·1	204	48·5
59	29 7	205	4·0
60	55·7	191	7·3
61	11·5	185	39·6
62	27·3	199	2·8
63	85·2	163	51·8
64	14·1	204	5·5
65	31·5	261	7·5

TABLE IV.—*Winter Laying (3rd November—28th December) in Relation to Annual Production and Size of Eggs (Wyandottes)*

	First and Second Periods.		*Yearly Averages.*	
No. of Eggs.	*No. of Birds.*	*Average No. of Eggs.*	*No. of Eggs.*	*Percentages of 2nd Grade Eggs.*
0	12	0	165	8·5
1 to 10	66	5	190	28·2
11 ,, 20	78	13	192	22·0
21 ,, 30	30	22	206	26·7
Over 30	12	33	230	18·2

As it is unsafe to draw conclusions from the performances of single pens, results have been collected of the number of eggs laid by groups of pens during the first two periods (November and December), in order to determine the extent

to which the size of eggs over the whole year is related to winter production. The results are given in Table IV.

The relation between the total annual egg production and the size of egg is shown in Table V.

TABLE V.—*Average Egg Production in Relation to Size of Egg.*

Group. No. of Eggs.	*No. of Birds.*	*Average Production.*	*Percentage of 2nd Grade Eggs.*
151 to 160	12	155	8·6
161 ,, 170	18	164	25·6
171 ,, 180	18	176	14·3
181 ,, 190	36	183	24·6
191 ,, 200	30	191	19·7
201 ,, 210	48	205	24·7
211 ,, 220	12	217	20·2
221 ,, 230	6	220	30·0
Over 230	18	235	32·6

The percentages of production as given in Table I indicate that, by selection and efficient management, a steady output of eggs can be maintained throughout the entire year. While the maximum is attained during the spring cycle (February-May), the variations at other periods are less than might have been expected. It will be noticed that Leghorns did not compare favourably with Wyandottes, Rhode Island Reds and Plymouth Rocks, a matter of surprise, considering that Leghorns are non-sitters, whereas the others are usually sitters during the fifth, sixth and seventh periods.

Table II is worthy of study. It will be noticed that while there are considerable variations in accordance with the season, yet the variations seem to follow a consistent rule. The proportion of eggs failing to reach market standards is considerable. In this respect the Rhode Island Reds show the most marked improvement from the first period.

The graphs show that size of egg increases with greater production, although not in relative proportion, during the earlier periods of laying, and that during the later periods, when production declines, the size of the egg is maintained.

It is further shown that all breeds lay smaller eggs in the first two periods, and that the increase therefore takes place after the first eight weeks.

From Table IV it would appear that, with the exception of the two pens which produced no eggs in the first and second periods, and gave the lowest annual averages of second grade eggs, there is no affinity between winter laying and the percentage of second grade eggs. The eleven pens of Wyandottes which laid an average of 5.1 eggs in the first and second periods, gave over the whole year an average of

28.2 per cent. second grade eggs, and the two pens which produced 33.2 eggs in first two periods laid 18.2 per cent. of second grade eggs.

On the other hand, with notable differences, it would seem (Table V) that the number of second grade eggs laid is influenced by the total annual egg-laying capacity; the larger the annual production the greater is the percentage of second grade eggs.

Further evidence is obtained by a study of the details from records of pens of White Wyandottes given below.

Four Pens producing an Annual Average of 220 Eggs and over.

Pen No.	First Period. Average Production.	First Period. No. of 2nd Grade Eggs.	Percentage of 2nd Grade Eggs in Last Period.	Whole Year. Total Eggs laid.	Whole Year. Percentage of 2nd Grade Eggs.
23	17·8	64	1·6	220	30·0
36	7·5	80	26·0	231	39·5
45	3·2	89	73·0	235	51·5
65*	15·3	51	12·6	261	7·5

* This flock quickly improved, and maintained a higher proportion of 1st grade eggs.

Five Pens producing an Annual Average of 180 to 190 Eggs.

Pen No.	First Period. Average Production.	First Period. No. of 2nd Grade Eggs.	Percentage of 2nd Grade Eggs in Last Period.	Whole Year. Total Eggs laid.	Whole Year. Percentage of 2nd Grade Eggs.
42*	8·83	18·9	57·1	187	8·9
46	3·5	42·8	17·2	183	23·2
53†	0·0	0·0	3·1	185	12·3
54	3·0	72·2	40·4	184	46·5
61‡	3·0	16·7	21·8	185	39·6

* Until the last period the percentage of 2nd grade eggs was very low

† 11·76 per cent. 2nd grade eggs in second period.

‡ Average of 2nd grade eggs greatly increased, being 61·4 per cent. in fifth period.

In only thirteen instances were all the eggs produced within any one period of first grade standard. Of these, one was in the third period, one in the fourth, one in the fifth, two in the seventh, three in the ninth, two in the eleventh, one in the twelfth, and two in the thirteenth period. In the large proportion of cases, where small eggs are laid during the first and second months, the size of the egg is below standard during the remainder of the year.

The figures submitted, so far as the four breeds dealt with are concerned, would clearly show that, while early laying has, in the majority of cases, an influence upon the size of eggs throughout the year, and also on total productivity, yet there are enough exceptions to indicate that size of egg is largely a matter of breed or strain. In order, therefore, to obtain a standard sized egg throughout the year, attention should be devoted to the production of a larger egg during the winter. Size should not be entirely sacrificed to numbers.

GOVERNMENT ASSISTANCE TO HORTICULTURE:

ITS LIMITS AND ITS POSSIBILITIES.

WM. J. LOBJOIT, O.B.E.,
Controller of Horticulture, Ministry of Agriculture.

EXPECTATIONS as to Government assistance to horticulture are not infrequently based on a failure to appreciate what are and what are not the functions of a Government Department. In the demands and criticisms which one hears and reads there is evidence of two distinct and divergent lines of thought among growers as to what the Ministry should do and what relationship it should maintain to the industry.

There are those whose conception of the whole duty of Government is expressed in three words: "Let us alone." The persistent neglect of agriculture, which in past days was the occasion of almost universal grumbling, is now looked back upon with wistful regret as a paradise lost. Most people, however, have come to realise that modern society has grown too complex for Government to adopt the role of merely keeping the ring while competing interests tear each other according to the law of the jungle; the community in general looking on and taking its chance, whether of benefit or suffering. You cannot bring back the water that has flowed under the bridge, nor can you put back the hands of the clock. During the years 1914 to 1918 civilization sailed into a new latitude and it has had to set its chronometers to a new Meridian. There is a changed atmosphere; there is an expanded outlook; there is a new philosophy of life, affecting those who think and those who exist without thinking. You cannot go back to the untrammelled individualism of the isolated country-side. The functions of Government are extended and extending by force of a world-wide impulse. On all hands there is the regulation of liberty in order that the essence of liberty may be preserved. There are, however, those who expect Government to do almost everything for them; a mental condition begotten of the nightmare of the war period when Government invaded the very altar places of home and in the manifest impotence of individual effort men looked to Government for deliverance. Just as there is the call so there are the limits to what a Government can do for Horticulture.

It can neither supply capital, nor individual initiative. It

cannot find judgment nor give financial prudence. It can make knowledge available but the acquirement must rest with the individual. Nor can it—and this seems to be the chief note in much criticism that has been passed on the Ministry—deliver growers from the necessity of facing up to the competition of produce from overseas. The fiscal policy is for the country through Parliament to settle.

Association of Growers.—There is a range of subjects in which growers in combination can do what the individual acting alone cannot.

Among these are questions of railway and other transport, markets, matters requiring agreement upon a common policy for the industry. Growers, in co-operation with the Ministry, can combine for conducting experiment and research as is done at Lea Valley and Malling. Last but not least, growers can always participate in the exhilarating sport of criticising and even of fighting the Government. There is still left a wide territory which can only be occupied by Government action.

Government Action.—But Government action does not necessarily mean—though it is generally taken to mean—action of the policeman type coming with a summons in his pocket. There is that wider and much more general police action of protection against the aggressor, of safeguarding interests menaced by the evil doer, and there is action of the "fire engine" type which comes to preserve property threatened by destruction. Whatever in the past may have given occasion for suspicion of Government action and given rise to resentment of the visit of an inspector as an invasion of the liberty of the subject, it is the anxious desire of the Ministry to dispel suspicion and to prove itself to be the friend of every section of the industry, the co-operator in every useful development, the protector of its interests against every assailant—its eyes in the investigation of problems and its intelligence wing in research.

To secure that this shall be so, elaborate arrangements have been made for frequent consultation between the Ministry and representatives from all branches of the industry. There is the Horticultural Advisory Council with its Sub-Committees of Nursery, Fruit and Vegetable Growing, Glass House, Marketing and Distribution, Bee Keeping and Willow Growing.

At the foundation of a horticultural policy is the question of statistics. Probably no industry in the country stands in such an unfurnished condition in this respect as does that of horticulture. That the industry is important— that it represents the

investment of much capital, and gives employment to large numbers, everyone knows—but who can fix precise figures to the general statements? Yet to know the dimensions of the industry is surely a reasonable pre-requisite to defining a policy in regard to it. It has been said that the value of statistics to a Government Department is patent, but what benefit can they be to the grower? It is very much like stating that anyone can see the value of diagnosis to a physician; but what benefit can it be to the patient? In the recent inquiry as to railway rates the absence of accurate statistics has weakened the case for the industry. There are violent fluctuations of prices for vegetables. Is the cause over production or lack of transport or faulty distribution? Statistics alone can prove it. In times of glut, too, is importation the cause or is it a question of reorganising transport? Statistics are necessary before an answer can be given.

No doubt at the mention of statistics the grower sighs and says "More forms." But here his fears are groundless—for though there must be the filling of schedules, expert assistance for this purpose can be given from Committees comprised of representatives of growers' organisations, the County Horticultural Staff and the inspectorate of the Ministry. The schedules are the product of conference between the national organisations of growers, the Horticultural Advisory Council and the Ministry. They are designed to obtain an accurate, detailed record, in the first instance, of fruit growing of all types in the country and of the nursery and glass house industry, with provisions for building up a system of reliable forecasts of the fruit crop, obtained in time to give warning to growers overseas when there is a large crop in this country.

The collection of statistics on the lines above indicated has been deferred for the present in view of the need for economy.

Plant Hygiene.—If an accurate diagnosis of the conditions of the industry is the foundation for a Horticultural policy, the next step will be to take measures to defend the horticultural stocks of the country against the attacks of diseases and pests. These can either be brought into the country upon imported produce or can be spread by the distribution of home grown stock as carriers. In the first case dealing with imported produce is necessary, and here it is evident the industry is dependent upon sympathetic Government action. The matter is not an easy one in any case, and is made more difficult by the disagreement among experts of how best to do it. The provision made and the powers taken to protect the live-stock herds against infection,

form some analogy of the course that may be taken. Inspection and certification by the authorities of the exporting country, where an effective system for this purpose exists, and where it does not, inspection at the port of landing before distribution in this country, form the basis of the plan with, in the background, the power to prohibit importation altogether, where such a drastic measure becomes necessary.

Next in importance is the health of the home stocks. Growers can be assisted in this matter by means of inspection of nurseries so that in all cases where it is possible to do so a certificate of health can be given, which the holder may use and quote to his clients, and powers to secure punishment of those who, reckless of the damage they may do to the industry and the community at large, send out plants seriously affected with diseases or pests.

This fight for health has become a vital matter to the industry. With the relative position attained by costs of production and the wholesale price obtained for produce, the saving of the waste seems to be the only way of escape for the grower.

Purity of Stock.—Next to health comes purity of stock and fidelity to type. Notwithstanding the laudable and costly efforts made by our nurserymen and seedsmen to improve and to fix standard types the battle has yet been scarcely more than an affair of outposts, but the lines have been pretty clearly laid down and much useful ground covered at Malling. Experiments with regard to Strawberries, Raspberries and other fruits are now being conducted at Long Ashton, but there is scarcely a form of fruit or vegetable produce in which the field for investigation, in this respect, is not almost unlimited. Then there is the matter of production of new types which has hardly yet been attacked in a comprehensive and scientific manner. In all these matters the Ministry so far as its resources permit is ready to lead the way for the industry, so that the problems that are constantly arising may be effectually tackled.

Value of Fruit Shows.—All this is in the production line. The more efficient and successful you make production the greater the obligations imposed upon you to find an outlet for the consumer. Here again you come into almost uncharted territory and the Ministry can offer to the industry services that cannot be substituted. It is proposed to make a beginning with apples—it is safe to assert that the general public is ignorant of what the home commercial grower can produce of this fruit.

The series of commercial fruit shows which began with Kent and has gradually been extended to other fruit growing centres has already served to quicken the interest and stimulate the spirit of emulation among fruit growers. These shows serve to afford information of what the more progressive and scientific growers are accomplishing. They are dispersing the old idea that any grower can gain by a policy of selfish seclusion; they serve the purpose of education by bringing the growers together for mutual counsel, and for the discussion of topics of general interest; they afford stimulus from the sporting spirit of competition; they serve to enlighten the public of what home growers are striving for, and they demonstrate what with skill, courage and persistency the most advanced have accomplished; they serve also to concentrate attention on those varieties of fruit which are best calculated to meet the public taste. But shows in fruit growing centres are insufficient. It is necessary to have a crowning edifice in London where entries which have obtained a prize in the Provincial Shows may be brought together and re-staged in competition with one another—if possible for some substantially attractive prizes for the best among the best.

The home grower has hidden his candle under the bushel too long. Too long has he neglected advertisement. It is a modesty which is not convenient, and it has given long measure to the illusion that if fruit that is attractive for the table is desired, one must get it from overseas supplies. The undoubted excellency which home grown fruit has attained, has yet to be brought home to the citizens of the metropolis and the provincial capitals of industry. This is a matter in which Government support can be helpful to the carrying out of any extended enterprise. It is satisfactory to note that arrangements are well under way for the organisation of a show of commercial fruit in London in the forthcoming summer on a scale such as has never been attempted before.

The commercial fruit show in the fruit growing area may be called "educational"—this to be held in London may be called a "demonstration" show. It is fitting that the first demonstration show should be held in London—the hub of our Empire. It is well to enlighten the citizens of the metropolis first—but it is not enough to do this and stay. The teeming populations of our commercial and industrial centres are equally unenlightened in this respect, and it is part of the proposed plan in subsequent years, to hold a demonstration show in each of the principal provincial cities.

When the home grower has by these means demonstrated to the British public that he can produce fruit of the finest quality and present it in a manner to suit the most refined taste, there must be set on foot a campaign of propaganda to secure that the home grown fruit shall have its full and rightful place in the dietary of the people. It must strike anyone who gives the matter a moment's thought that this is most assuredly not the case at present. Without referring to ordinary domestic uses, it is sufficient for the moment to ask the question: at how many dinners or banquets, even of the highest class, does one see a provision for dessert of such a nature as to encourage the consumption of home grown fruit? The order of events must be first the demonstration of what the home grower is accomplishing and then the propaganda to extend the use.

Grading and Packing of Fruit.—The encouragement of an extended culture of fruit must have its counterpart in the propaganda to encourage the extended use of fruit, which, if it can be attained, will justify itself not only upon economic grounds, but on the higher plane of health. These considerations involve the form of package to be used, the lines on which fruit should be graded and the methods of packing to be recognised, the standard of quality, and any possible limitation of the varieties to be recognised. As a beginning has to be made, it will be well in the first instance to confine attention to the apple, which is the most widely used of any form of fruit capable of being grown at home. It is common knowledge among growers and all who deal with apples that the popularity which the imported apple has attained in this country is due to the use of a standardised package selected because of its suitability for shipment purposes, the adoption of a consistent system of grading which has been imposed by Government action, to scientific methods of packing, and to a high condition of soundness in quality, while the continuity of supply which results from concentration upon a comparatively few varieties of ascertained quality has added to these other advantages and given to the imported apple a distinct lead.

The Ministry does not wish to impose upon the trade the use of any form of package, but would rather that the trade (and, by the term "trade" in this connection the Ministry understands not only the growers, but wholesale salesmen and retail distributors), should come together and arrive at an agreement as to what packages should be standardised. The same system will apply to the other items of grading, packing, standard of quality, and of recognised sorts. Upon each of these matters

the industry is asked to come to an agreement. When this measure of agreement is obtained. the next step to consider is how to put it into practical operation for the benefit of the industry and the country in general. There are those who favour legislation, giving to the agreement arrived at by the trade, the force of law, but this would not necessarily be the best method of securing the willing co-operation of the growers, and the popularity of the method. A far better method would be to make use of the motive of self interest and by the voluntary co-operation of the growers themselves, demonstrating the advantages of the system. To effect this an authorised label to be used only for apples which are packed in the manner agreed to by the trade and authorised by the Ministry might be adopted. The label could be issued by the Ministry to organised growers under a guarantee to observe certain conditions.

These conditions would be (1) An authorised system of grading; (2) An authorised system of packing; (3) An authorised standard of quality; and (4) A recognised commercial variety. The label would bear, distinctly marked on it, the grade, the number of weight of the contents, the variety of the apple, and some distinction mark to identify the grower. The label would thus be a symbol to all buyers of honest fruit.

The apples of any one variety whether grown in the North, South, East or West of England, packed according to these conditions and of the same grade would be so similar that they could be stacked together in the market and sold in bulk. A buyer would thus have the advantage of continuity of supply, which at present unfortunately only goes with fruit grown overseas. The saving of labour and space to the salesmen in busy markets is evident, and some might be reflected to the grower in reduced salesmen's charges. The main advantages to the grower, however, would be that ruinous slumps would be avoided. As all sales would be from standard samples no individual consignment need be neglected. An auxiliary to this policy would be the taking off the market of all scabby and misshapen apples which now tend to lower the price and to spoil the home grown apples, and the use of such fruit in manufacture.

It may be mentioned, in conclusion, that by the Agriculture Act, by the legalising of what is known as the "Evesham custom" and by other provisions, long-standing grievances of which commercial horticulturists complained, are removed, and to the encouragements to the extension of intensive cultivation described above is now added that of a larger measure of security for capital invested in improvements of the holding.

"ISLE OF WIGHT" DISEASE OF BEES.

The disease of bees called "Isle of Wight" disease has recently come into prominence on account of some interesting papers that were read before the Royal Society of Edinburgh on 1st November, 1920, by Dr. J. Rennie, and his collaborators, Miss Elsie J. Harvey, and Mr. P. Bruce White, B.Sc., on their recent discovery in connection with this malady. Before dealing with these papers, however, it will perhaps be as well to give a rapid survey of the history and progress of this disease, and the investigations that have been made into its cause since it first appeared.

The name "Isle of Wight" was given to the disease because the first serious outbreak occurred in that Island in 1904, since when it has engaged the continuous attention both of the Ministry and practical and scientific bee-keepers. From 1904 to 1906 the disease spread slowly, but in the latter year its progress became more rapid, until in 1907 practically the whole Island was affected and bee-keeping there became an unprofitable industry.

The symptoms of the disease are as follows:—Listlessness of the bees; dislocation of one or both posterior wings, and distension of the abdomen; the staining of the alighting board and combs with excreta of the consistency of putty; crowding of the bees on the outside of the hive, and, in severe cases, owing to their inability to fly, crawling about in thousands on the ground or ascending upright objects, and at times collecting in small clusters eventually to die.

Many theories in earlier times have been advanced as to the cause of the disease, including infection from poisonous plants, from tar spraying of the roads, from spraying fruit trees and potatoes, from damaged pollen collected and eaten by the bees, inbreeding, want of ventilation, fungi, yeasts, artificial feeding, and modern methods of bee-keeping. In 1907, at the request of the Board, Mr. A. D. Imms, B.A., Cambridge University, carried out an investigation of the disease in the Isle of Wight itself. He came to the conclusion that it was due to digestive trouble, and gave an account of his investigations in this Journal in June, 1907. Shortly afterwards Mr. Imms went to India, and his work of investigation was continued by Dr. Graham Smith, in conjunction with the late Dr. Malden, of Cambridge University. They reported that all the

affected stocks in the Island had by that time died off, and that the disease remained in abeyance until the middle of June, when it broke out again with greater virulence. They formed the opinion that the conditions described by Mr. Imms were the result and not the cause of the disease. They also shared the opinion of the practical bee-keepers on the Island, that the disease was highly infectious and that the drinking places visited by the bees were a source of contamination.

In 1911, the disease made its appearance in England and Scotland. Dr. Malden continued his work and was assisted by Dr. Fantham, Dr. Annie Porter, and Mr. Bullamore. The general conclusion which these investigators arrived at was that the disease appeared to be caused by a parasitic organism, "Nosema Apis," a member of the group known as "Microsporidia," which carried out its life cycle in the intestines of the bee. The name "Microsporidiosis" was accordingly given to the disease. Investigators in other countries, Zander and Massen in Germany, and Nussbaumer in Switzerland, also came to the conclusion that "Nosema Apis" was the cause of the disease.

Attention was now devoted to finding a cure for it. Several drugs were tried with varying results, but no definite and certain remedy could be found. Investigations were then carried out at the University of Aberdeen and the Aberdeen College of Agriculture by Dr. Rennie and Mr. Anderson, the latter eventually questioning whether "Nosema Apis" was, in fact, the cause of the disease. Dr. Rennie was later assisted by Miss Elsie J. Harvey and Mr. P. Bruce White, B.Sc. Their investigation led to the discovery, early last year, of a parasite of a remarkable kind, belonging to the genus "*Tarsonemus*," hitherto unknown in bees. The *Tarsonemes* include several species destructive to plants, and there are some which have been found in malignant growths in man and in animals; in structure the bee *Tarsoneme* appears to be most closely allied to these last. This creature, which is specialised in structure, is bred within the bee and is confined to an extremely limited, but very important region of its breathing system. Within the space of a few cubic millimetres scores of these creatures may be found in all stages of development, sometimes so densely packed as to cut off effectively the air supply from the surrounding organs. The detailed pathology described in Mr. White's paper proved the destructive character of the parasite's habits. Thousands of bees have been examined from large numbers of stocks throughout the

country, and it was found that every stock reported by reliable bee-keepers, or certified by the investigators themselves, as suffering from the disease, harboured this parasite, while "Nosema Apis" was not always present. Similarly, every individual bee known to be suffering from this disease from its stock history and individual symptoms, was also found to contain these parasites, and to exhibit the internal disorders which caused the disabling symptoms. The investigators stated that they were now able to diagnose the disease in its earliest stages, while the bees were capable of flying and foraging. Infection appeared to occur mainly in the hive, the conditions of the cluster making this comparatively easy. In support of thi theory, mites have been obtained from the outside of the bee apparently on their migratory passage.

In the light of this discovery much that was puzzling in the symptoms of the disease appears to be cleared up. The mite infests the trachea of the thorax only, entering by the spiracles, and breeding takes place here, until eventually the trachea becomes partially or wholly obstructed. In the latter case the bee dies at once, while in the former, being unable to fill the air sacs which permit of flight, it is reduced to crawling. In such cases the fæces are not evacuated, as normally this is accomplished when the bee is on the wing, and hence arises the congested condition of the bowels, and the consequent staining of the combs, hive front, and alighting board.

Interesting experiments were carried out by blocking up the thoracical spiracles of the bee with wax, and by this means all the usual symptoms of "Isle of Wight" disease were produced. Tests were also made on young bees which were hatched from combs in an incubator and from which all the adult bees had been previously removed. Out of the 157 young bees that were examined only one was found to be affected with "Tarsoneme"; this may have remained on the comb, and entered the bee after it had emerged from the cell, so that it is reasonable to suppose that young bees are not affected. This supposition is further strengthened by the fact that in the past, stocks apparently have been cured, and have given surplus honey by making an artificial swarm from the affected stock; the swarm, consisting of all the old infected bees being destroyed, and the young and hatching bees allowed to carry on the work of the hive.

Many bees from different countries outside Great Britain have been examined, and so far "*Tarsonemus*" has not been found in them. All the evidence obtained points to this parasite in bees being peculiar to this country.

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As some recognition of the interest taken by Mr. A. H. E. Wood, the director of the research proposes to designate the new species "*Tarsonemus woodi.*" The investigators also recorded their high appreciation of the support of bee-keepers throughout Great Britain, and also of the Ministry of Agriculture and Fisheries in supplying bees, and rendering other assistance so essential for the successful conduct of the research.

In conclusion it may be said that the discovery appears to be an important one for the bee-keeping industry, and there seems little doubt that the causal agent of "Isle of Wight" Disease has at last been traced. It remains, however, for other investigators to corroborate or refute the conclusions arrived at by Dr. Rennie before the discovery can be wholly confirmed and accepted. Dr. Rennie, to whom great credit in the matter is due, will now devote his time to finding a means of combating this pest. He suggests that the name "Isle of Wight" disease, which is unsatisfactory, might be changed to "*Acarine*" disease.

NOTES ON MANURES FOR APRIL.

E. J. RUSSELL, D.Sc.,
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Manures for Potatoes.—This is the season when manures must be applied for potatoes. The best preparation is a good dressing of farmyard manure in the previous autumn in England, or in spring where the winter rainfall is heavy as, probably, in Wales. Where sufficient dung was not available in autumn the remainder is applied in the drills.

Artificials must always be added. Satisfactory results have been obtained by the application at the time of planting of 1 cwt. of sulphate of ammonia, 4 cwt. of superphosphate, and 1 cwt. of sulphate or muriate of potash per acre. If, however, the soil and climatic conditions are such that 9 or 10 tons of potatoes per acre may be expected then the following mixture would be justified: 1½ cwt. of sulphate of ammonia, 4 cwt. of superphosphate, and 1½ cwt. of sulphate or muriate of potash.

In special cases even higher dressings can be used, but only when direct experience shows a definite advantage. Cases are on record when a shortage of dung was satisfactorily counterbalanced by increasing the sulphate of ammonia to 2½ cwt., with corresponding increases in the superphosphate to 6 cwt. and in the sulphate of potash to 2 cwt. per acre.

Some farmers have asked whether anything is gained by adding magnesium compounds to a potato manure. Certain Scotch farmers have used magnesium in the form of oxide or carbonate, and claim to have obtained satisfactory results. One of the successful Scotch growers in Hertfordshire has applied magnesium compounds. The writer was unable to find, however, that any advantage was gained thereby, but precise evidence is lacking. Magnesium sulphate or chloride could be more readily obtained: the effect is being tested during the present season at Rothamsted.

Sulphate of ammonia is generally found better for potatoes than nitrate of soda, nitrate of lime or nitrolim, and should therefore be used unless there is evidence that the nitrate would be more effective. Whenever there is any reason to fear scab sulphate of ammonia and superphosphate would be necessary, but in soils where scab does not generally give trouble, and in certain other cases also, a mixture of basic slag

and superphosphate can be used instead of superphosphate. As a general rule, however, the mixture given above has worked satisfactorily.

Manures for Mangolds.—As in the case of potatoes, the best preparation for mangolds is a dressing of farmyard manure, applied in the previous autumn if possible in the case of most of England, but in spring in districts where the winter is very wet. Many dairy farmers in the Home Counties have used little else, but this is not a satisfactory method of treatment unless dung is very cheap. Better results are obtained by the use of not more than 20 loads of dung, supplemented by artificials.

The following mixture has proved satisfactory: 1 cwt. of sulphate of ammonia, 3 cwt. of superphosphate, 4 cwt. of kainit or sylvinite, and 2 to 4 cwt. of salt in the drills, and 1½ cwt. nitrate of soda as a top dressing when the plants are singled and hoed.

The dressing seems heavy, but owing to the importance of the crop liberal manuring is quite justified. In the case of mangolds nitrate of soda gives better results as a top dressing than sulphate of ammonia; experiments show that nitrate of lime is also effective.

Kainit or sylvinite are suggested in preference to other potash manures because the salt present is of value to the mangold crop. Even when 4 cwt. of these fertilisers are used, however, mangolds would often respond to further dressings of salt.

Swedes and Turnips.—These crops require altogether different manurial treatment from the preceding. If grown without dung they need large quantities of phosphate, and sufficient, but not excess, of nitrogen. A useful dressing in this case would be, in the southern part of England: 4 cwt. of superphosphate or 6 cwt. of basic slag, and 1 cwt. of sulphate of ammonia. If, however, climatic and soil conditions favour a yield of 18 tons or more per acre, the following could be used: 6 cwt. of superphosphate or 8 cwt. of basic slag, 1 cwt. of sulphate of ammonia, and 1 cwt. of sulphate of potash in the drills, followed by 1 cwt. of nitrate of soda as a top dressing at the time of singling.

Where, however, dung is applied it is very doubtful whether artificials are required at all. In numerous careful experiments there has been no response to the additional artificials. The phosphate and potash would of course remain in the soil for future crops, but the ammonia would be lost.

Examine Clover Leys now.—Now that the winter is over careful inspection of the clover leys is desirable to ascertain whether the general soil conditions are suitable or whether there is a need of lime and of phosphates. The writer is convinced that many farmers suffer unnecessary loss of this most valuable crop simply through lack of lime and phosphates. The best time for applying these is at or before the sowing of the clover seed, when, as pointed out last month, there is a marked response in the growth of the young plant. The advantage of inspection now is that it affords guidance for the treatment of seeds to be sown this year: if last year's crop is patchy and the plants are not as healthy as they should be, the newly sown seeds should be well dressed with basic slag.

Difference between Kainit, Sylvinite, Muriate of Potash and Sulphate of Potash.—Our correspondence shows that there is some confusion in the minds of farmers between these substances.

Sulphate of potash is well known, and being a single substance is always of the same composition so long as it remains of the same degree of purity. It can be used on all crops needing potash, and is free from harmful effects on quality.

Muriate of potash is also well known to farmers, and in most cases can be used as freely as sulphate of potash, with the certainty that it will supply the requirements of crops needing potash. There have been statements that it sometimes injures quality, but the writer has found no direct evidence that this is the case. Careful trials are being made this year.

Kainit is a mixture of substances graded so as to contain about 12½ per cent. of pure potash (K_2O), most of which appears to be in the form of muriate. Before the War it consisted of about one-third of its weight of common salt (sodium chloride), about one-third of magnesium salts (apparently chiefly as sulphates), while the remaining third was muriate of potash with water of crystallisation. It is known to be of great value on mangolds and grassland, where probably all its constituents help the crop.

Sylvinite is a newcomer among fertilisers and is being vigorously handled by the Company responsible for the development of Alsace and Lorraine, where it is found. One grade is sold to contain 12 to 14 per cent. of pure potash (K_2O), and this is comparable with kainit; a higher grade contains 20 to 22 per cent. of potash. Both differ from kainit in containing no sulphate of magnesia but only muriate of potash and

muriate of soda (common salt). The lower grade contains approximately 19 to 25 per cent. of muriate of potash, 60 to 66 per cent. of muriate of soda, 2 to 5 per cent. of sulphate of lime, and 10 to 12 per cent. of insoluble matter; the higher grade contains approximately 32 to 35 per cent. of muriate of potash, 50 to 55 per cent. of muriate of soda, 2 to 5 per cent. of sulphate of lime, and 9 to 10 per cent. of insoluble matter. Either grade would be worth trying on mangolds or grassland. The effect on potatoes is being carefully tested this year at Rothamsted.

Confusion between Chalk, Lime and Limestone.—Instances have been brought to the writer's notice of a confusion between lime and limestone or chalk, which is adversely affecting some of the farmers in whose minds it exists. It is unfortunate that these words are all used in rather a loose way, as if they meant the same thing. They do not, and there is really a considerable difference between them. In buying lime the farmer should be perfectly certain as to what the analysis means, and if he is in any doubt should communicate with the County Organiser. If one invoice guarantees 90 per cent. of pure chalk or pure limestone or pure calcium carbonate, and another guarantees 50.4 per cent. of pure lime *or* pure oxide of lime, these two quantities are not different but the same. There being no legal form of guarantee a dealer is fully justified in describing the material in whatever way he thinks most attractive, but the farmer who is buying should be perfectly clear in his mind what it is he is getting.

FEEDING STUFFS IN APRIL.

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IN last month's notes it was stated that eggs contained all the vitamines considered essential to the well being of the young growing animal. It should have been stated that eggs, like most animal products, are deficient in the anti-scorbutic factor. Although our present knowledge does not enable us to state whether this factor is indispensable as a component of a normal growth dietary, it is well to mention its absence in order to remove any misapprehension which may arise through the statement made. The anti-scorbutic factor is of course abundant in most fresh vegetable foods, such as cabbage, swedes and carrots.

Farm and Consuming Values.—It will be noted that the expression "consuming value" as applied to potatoes, swedes, mangolds and silage, has been replaced in the table by the term "farm value." The object of this is to avoid the possibility of confusing the value given with the value assigned to farm goods by valuers. The "consuming value" of a food, as given by valuers, is arrived at generally by taking two-thirds of the market value of the food, after allowing for costs of marketing and residual manurial value. The figures given in the table, however, represent the actual value to the farmer for feeding purposes on the farm, together with the manurial value, and do not allow for cost of marketing. The value assigned by a valuer to potatoes on a farm will, as a general rule, have quite a different value to that given in the table.

Maize and Maize Products.—An average sample of maize contains approximately 1.5 per cent. ash, 2.2 per cent. crude fibre, 4.5 per cent. oil, 10 per cent. protein and 70 per cent. starchy material. It is relatively high in oil and starch, medium in protein, and low in fibre, and is, therefore, pre-eminently a fattening foodstuff. The protein of maize by itself is unsuitable for young growing animals, so that if maize is used it must be supplemented with foods rich in protein and mineral matter. In the case of growing and breeding stock, maize or maize meal should in no case exceed one-half of the ration, about one-third being the best proportion. Oats or bran with linseed meal, lucerne or clover hay, and pasture are suitable additions to a maize dietary.

In the case of fattening stock, particularly pigs, maize or maize meal may form with advantage the bulk of the food. Whether the maize should be given whole or crushed, or in the

form of meal, depends on the class of stock and the judgment of the feeder. In the case of cattle a proportion of the whole grain passes through the digestive system unchanged, and it may be an advantage in this case to run pigs with the cattle. In the case of lambs, the maize should be finely crushed, but it is considered best to feed sheep with whole maize. In the case of pigs the maize is best fed in the form of meal, and it is advisable to soak the meal well before feeding.

Maize By-products.—The use of maize and maize products for human food gives rise to a large number of by-products, including maize bran, gluten feed, gluten meal, maize germ meal, corn oil cake, hominy chop, hominy feed, and brewery by-products such as distillers' grains.

Maize bran consists of the whole of the maize and has a low feeding value. *Gluten feed* consists of a mixture of all the by-products obtained in the manufacture of maize starch, and can be regarded as the maize grain with most of the starch removed. It is rich in oil and protein and is well suited for dairy and fattening stock. *Gluten meal* does not contain the whole bran or the embryo, and differs from gluten feed in this respect. It is a concentrated feeding stuff, and may be used in the same way as gluten feed.

Maize germ meal or cake consists of the embryo or maize germ from which the oil has been extracted. It is a very concentrated food and should be used in conjunction with other grain feeds. *Corn oil cake* consists of the pressed embryos, contains a considerable quantity of oil, and, like maize germ meal, is a highly concentrated feeding stuff. *Hominy chop* and *hominy feed* consist of the whole grain and starchy refuse from the hominy factory. They resemble maize itself from a feeding standpoint, and are of about equivalent value lb. for lb. They are valuable for fattening animals and milch cows. *Distillers' grains* obtained from maize are valuable as a feed for dairy cows, and may replace part of the oat ration for working horses, but owing to their fibrous nature are not suitable for pigs.

The following table shows the chemical composition of the various by-products :—

	Water.	*Crude Protein.*	*Oil.*	*Nitrogen free extract.*	*Crude fibre.*	*Ash.*
Gluten meal ...	9·2	36·9	3·9	46·7	2·2	1·1
Gluten feed ...	8·5	25·7	4·4	53·5	6·7	1·2
Germ meal ...	9·1	23·0	10·7	45·6	9·0	2·6
Hominy feed ...	9·3	11·2	8·6	63·7	4·5	2·7
Distillers' grains	8·8	35·0	11·3	30·4	12·1	3·4
Maize bran ...	9·1	9·9	5·6	62·0	12·1	3·1

NAME.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	40/3	400	11 5	1 6	9 19	71	2/10	1·52
„ Foreign „ -	46/6	400	13 0	1 6	11 14	71	3/3	1·74
Oats, English „ -	41/6	336	13 17	1 9	12 8	59·5	4/2	2·23
„ Foreign „ -	33/-	320	11 11	1 9	10 2	59·5	3/5	1·83
Maize - -	55/9	480	13 0	1 5	11 15	81	2/11	1·56
Beans, English spring -	—	—	—	—	—	—	—	—
„ „ winter -	57/-	532	12 0	3 1	8 19	66	2/8	1·43
„ Chinese - -	14/6	112	14 10	3 1	11 9	66	3/6	1·87
Peas, English blue -	60/-	504	13 7	2 13	10 14	69	3/1	1·65
„ „ dun -	70/-	504	15 11	2 13	12 18	69	3/9	2·01
„ „ maple -	70/-	504	15 11	2 13	12 18	69	3/9	2· 1
„ Japanese* - -	137/6	504	30 11	2 13	27 18	69	8/1	4·33
Buckwheat - - -	72/-	392	20 11	1 9	19 2	53	7/2	3·84
Rye, English - -	54/3	480	12 13	1 8	11 5	72	3/1	1·65
Millers' offals—Coarse -	—	—	9 10	2 10	7 0	45	3/1	1·65
„ „ Fine -	—	—	10 10	2 10	8 0	64	2/6	1·34
Barley meal - - - -	—	—	16 5	1 6	14 19	71	4/2	2·23
Maize „ - - -	—	—	12 10	1 5	11 5	81	2/9	1·47
Bean „ - - -	—	—	16 10	3 1	13 9	66	4/1	2·19
Fish „ - - -	—	—	21 0	7 12	13 8	53	5/1	2·72
Linseed - - -	—	—	19 0	2 16	16 4	119	2/9	1·47
Cakes, Linseed - -	—	—	17 12	3 12	14 0	74	3/9	2·01
„ Soya - - -	—	—	—	—	—	—	—	—
„ Cotton seed -	—	—	10 0	3 5	6 15	42	3/2	1·70
„ Cotton seed decorticated*	—	—	18 0	5 6	12 14	71	3/7	1·92
„ „ decorticated meal	—	—	14 0	5 6	8 14	71	2/5	1·29
Coconut cake - -	—	—	10 10	3 0	7 10	79	1/11	1·03
Groundnut cake - -	—	—	—	—	—	—	—	—
„ decorticated	—	—	15 0	5 5	9 15	73	2/8	1·43
Palm kernel cake - -	—	—	7 10	2 1	5 9	75	1/5	0·76
„ „ meal - -	—	—	—	—	—	—	—	—
Brewers' grains, dry -	—	—	8 10	2 7	6 3	49	2/6	1·34
„ „ wet -	—	—	1 15	0 12	1 3	15	1/6	0·80
Distillers' „ dry -	—	—	11 5	2 16	8 9	57	3/-	1·61
„ „ wet -	—	—	—	—	—	—	—	—
Malt culms - - -	—	—	7 10	3 6	4 4	43	1/11	1·03
Potatoes† - - - -	—	—	3 0	0 8	2 12	18	2/11	1·56
Swedes† - - - -	—	—	1 6	0 5	1 1	7	2/11	1·56
Mangolds† - - - -	—	—	1 3	0 6	0 17	6	2/11	1·56
Vetch and oat silage† -	—	—	2 16	0 15	2 1	14	2/11	1·56

* Prices at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

AGRICULTURE ABROAD.

PICKERING SPRAYS—WHEAT IMPROVEMENT IN CANADA.

Pickering Sprays and Fungus Diseases.

THE United States Bureau of Chemistry has completed an investigation into the comparative efficacy of Pickering Sprays and of the standard Bordeaux Mixture, and the results are given in Bulletin No. 866 of the United States Department of Agriculture. Plant pathologists will remember that Spencer Pickering did considerable work on Bordeaux Mixture, made by treating dilute copper-sulphate solution with lime water. It was obvious that, if the results obtained by Pickering in the laboratory in England held good under field conditions in America, a great saving of copper might be effected. The investigation, therefore, sought to determine the amount of copper necessary, for a given quantity of spray, to ensure effective control of fungus diseases, while a comparison of the adherence of the sprays was also made. As a result of tests on potatoes, extending over three seasons, it was found that sprays made after Pickering's method, containing 7 per cent. of copper-sulphate, were as effective as ordinary Bordeaux Mixture containing 1.25 per cent. of copper-sulphate. Pickering's claim that the copper of his wash was 10 to 12 times more effective than the copper in standard Bordeaux Mixture was, however, not substantiated. Its adhesive property was, however, satisfactory, while no injurious effects on the plants were noted. Curiously enough, the Pickering Spray was not so effective on apples and grapes, and it also burned the foliage. Barium hydrate solution substituted for lime water also gave satisfactory results on potatoes.

* * * * * *

Wheat Improvement in Canada.

ACCORDING to *The Agricultural Gazette of Canada* for May last, the first serious effort made by the Federal Government to improve the wheat crop of Canada dates from 1886, when the Experimental Farms System was inaugurated. The objects were to improve existing grains and to introduce from abroad varieties that were hardy, high yielding, and capable of maturing in districts in which the season was somewhat short. Owing to Canada's geographical position and to the great climatic differences prevailing in the various Provinces, no single variety of either fall or spring wheat gives uniform results throughout

the Dominion. By breeding and selection, therefore, each Province is endeavouring to produce varieties of wheat that will not only give optimum results to the grower, but will also possess satisfactory milling qualities. Improvement of the wheat crop is also encouraged by the Canadian Seed Growers' Association* and by private individuals. That their united efforts have been attended with success there is no doubt. The result is demonstrated in two directions. First, doubtless in part owing to war conditions, the wheat acreage has been greatly increased: in 1918, it was approximately two million acres above the average acreage of the three preceding years, while in 1919 there was a further increase of another two million acres. Secondly, the value in increased wheat production owing to the specially selected cars of wheat which were recleaned and distributed at cost for seeding purposes throughout Canada can scarcely be estimated.

At first, twenty-eight varieties representing the produce of the chief grain-growing countries of the world were selected by the Dominion Department of Agriculture from grain offered for sale on the London Corn Exchange. Among these were four varieties of wheat from India, namely, Kurrachee, Hard Calcutta, Red Calcutta, and Club Calcutta, some of which proved valuable for breeding strains of high quality. Another was Bobs, a yellow branned wheat from Australia, from which the present Red Bobs is a selection. Practically the only variety of the earlier introductions grown to-day is Kubanka, a Durum wheat, which was tested out by the Experimental Farms in 1903-4. Among the first crosses made by a Fife wheat on those from Northern Russia were Preston, Stanley and Huron. Of these, Huron is the best; it is a red, bearded wheat well suited to the Eastern Provinces and parts of Alberta and Saskatchewan. In Northern Alberta, the Bishop variety has made a noticeable stand; it is comparatively early, it gives an excellent crop and yields a very good grade of flour. Then there is Marquis, the leading wheat of Canada, which has added enormously to the value of the Canadian wheat crop. Introduced by Dr. Chas. E. Saunders, Dominion Cerealist, Marquis is from three to twelve days earlier in maturing than some other varieties, and is very productive, especially on rich soils and in rather dry climates. It yields excellent flour, it does not readily shell out before cutting, the kernels are hard, and the straw is rather short, but stiff.

* See this *Journal*, January, 1912, p. 855.

Another cross-bred variety is Ruby, which ripens at Ottawa in about 93 days from the date of sowing, and is thus even earlier than Marquis. It yields well and is specially valuable in districts where Marquis is too late or where there is a moderate rainfall. Ruby wheat has helped to make profitable the growing of wheat in districts where grain crops were formerly ruined by frost. Prelude is also an early variety, ripening about 87 days from the date of sowing; it yields flour of very high baking strength, but it is not pale enough to be given the highest rank for colour. One of the most noteworthy strains of wheat produced by selection from commercial varieties is Early Red Fife. It is obtained from ordinary Red Fife, but is several days earlier and has a higher yield. Among other sorts are White Russian and White Fife. By the free distribution of 5-lb. samples of wheat, through the agency of the Experimental Farms, the Dominion Government is encouraging the growing of high-yielding, good flour-making wheats suitable to the wide variety of conditions found in Canada.

Private growers also aid in the work of producing new or improved varieties. The foundation stock resulting from selection of individual plants of outstanding merit is maintained and multiplied in its purity by farmers who specialise in seed growing. About three hundred such farmers are members of the Canadian Seed Growers' Association. The Association receives a grant from the Government and charges fees for registration of inspected seed, which is marketed as such. In localities well adapted to the production of wheat, growers of registered seed work in co-operation in what are known as seed centres. Registered seed provides the stock for field crop competitions, seed fairs and provincial seed exhibitions. These receive subventions from the Seed Branch of the Canadian Ministry of Agriculture, which also inspects and tests seed for farmers and seed merchants, besides supplying seed wheat through the Government Seed Purchasing Commission. Thus, when farmers or seed merchants are in doubt, samples are sent to the seed laboratories for germination tests.

Seed wheat exposed for sale must comply with the requirements of the Seed Control Act. It must be either free from noxious weed seeds or be labelled to indicate those present, and must be capable of germinating 68 per cent. or be labelled to show the exact percentage of germination. If sold according to grades, the standards must be maintained for those indicated,

namely, Extra No. 1, No. 1, or No. 2 seed. The Seed Purchasing Commission was established in 1916, primarily to provide emergency seed for the drought-stricken areas in the Prairie Provinces, but gradually it extended its operations until at the present time the quantity supplied to Western Canada alone runs into millions of bushels a year. Car samples of wheat in transit to Government elevators are sorted by Dominion seed inspectors, and those which can be cleaned to seed grade without serious dockage are treated accordingly. The seed inspectors also supervise the re-cleaning and issue seed certificates ex-elevator. Every car is sampled for germination tests to be made at the Dominion seed laboratories, while purity tests are made by the inspectors. The policy of providing an abundant supply of superior seed wheat will, it is anticipated, result in increasing the demand for the best quality only.

The Warble Fly Pest : An Appeal to Farmers.

EVERY farmer is familiar with the barrel-shaped maggots often to be found in large numbers just under the skin on the backs of cattle. These maggots are the grubs of the Warble Fly, and are the cause of enormous loss to farmers. The subject of this pest in cattle is engaging the attention of a Scientific Committee appointed by the Ministry. Experiments are in progress with a view to discover a remedy which must be cheap, safe and easily obtainable to combat the ravages of the Fly, and eventually to destroy the pest altogether. The only reliable process which has been recommended hitherto is that of "squeezing out" the warble maggots from the backs of cattle during the season of greatest growth, but this method of destruction is both lengthy and troublesome. The Committee have devoted their time to the finding of a satisfactory "dressing" which might be applied with safety to affected cattle, and one has given results so promising that it has been decided to invite farmers to try it as extensively as possible, with a view to its recommendation for general use.

The dressing is a wash, the principal ingredient of which is a tobacco powder. This powder is steeped in water for 24 hours, the liquid strained through coarse muslin, and applied with a cloth or brush to the backs of the cattle. The wash should be pressed into the warbles.

An infusion of 3 to 4 lb. of the powder, with 4 lb. of lime added, in one gallon of water gives the best results. With a wash compounded in this way it has been found possible to kill

from 80 to 96 per cent. of the maggots present in cattle subjected to experiment. A single application was in some cases sufficient to do this, but more certain results may be expected from dressing twice at an interval of 2 days.

The Committee wish, therefore, strongly to urge upon farmers the desirability of carrying out for themselves trials with the above-mentioned dressing during the Warble season. An admirable arrangement would be to apply the dressing to the cattle once a fortnight until May; in this way farmers will not only advance their own interest by rendering their stock immune to an objectionable and costly pest, but they will also assist the Ministry in a very practical manner. The great desideratum is that a result reached by patient experiment should receive repeated tests by practical men working under normal conditions. There is reason to believe that if this campaign is followed up and the experimental side of the Ministry's researches is carried from the Laboratory to the farm, the grievous trouble to cattle and the heavy loss to the farmer may come to an end within two or three years.

The Committee would welcome at the Ministry's Offices any communication from farmers interested in this matter, and would be glad to receive in due course reports as to the progress they may have made and the results obtained.

* * * * * *

The First World Congress on Poultry.

THE first "World Poultry Congress," to be held at The Hague and Scheveningen, in Holland, from September 6th to 13th, 1921, will be an event of international significance to poultry-keepers. This Congress will be an assembly of delegates from Governments, Teaching and Experimental Institutions, Poultry and other Societies, and persons interested in the development of poultry husbandry.

The Congress has been organised by the International Association of Poultry Instructors and Investigators. It was intended originally to hold the first Congress at The Hague in 1916, but the war made it necessary to postpone the meeting until 1921. The programme is remarkable in its range, including as it does papers and discussions relating to education, research, poultry hygiene and diseases, production, distribution, co-operation and standardisation. The exhibits will include the breeds and varieties of the world, the latest inventions in poultry equipment and appliances, educa-

tional methods, results of research, and the special literature of various countries. The main purposes of the Congress are to stimulate interest in poultry-keeping, and all matters relating thereto, to co-ordinate education and research in poultry-keeping in all countries, and to educate poultry-keepers in the most efficient and practical methods.

The titles of the sections and sub-sections afford sufficient indication of the exhaustive nature of the discussions and demonstrations to be held during the sittings of the Congress. There are four main sections, the *first* dealing with experiments, investigations, the science of breeding and its practical application, systems of incubation, brooding, general management and rearing. The *second* section will be concerned with State and official action, including reconstruction, together with opportunities for women in the poultry industry. It will consider also international and national trade in eggs, co-operation and the organisation of poultry societies. The *third* section is concerned with hygiene and diseases, and the *fourth* section will discuss the training and the necessary qualifications of instructors, and deal generally with education and demonstration work, as well as with the organisation and influence of Exhibition and Laying Trials. Nearly 100 different papers have been projected and these will be read by men and women of the highest authority in the poultry world. From the titles of these papers it will be seen into what an extraordinary number of subsidiary, although important, departments this industry is divided. Among readers in the first section occurs the name of Professor Punnett, who will lecture on his own subject—"Mendelism: the Poultry Industry and the Fancy." Professor Graham, from Guelph, Canada, will discuss the science of breeding and its practical application. Professor Chas. Voitellier, Professor of Poultry Husbandry, Paris, will be heard on the scientific bases of balanced feeding of fowls, with a discussion of variations in weight and composition of eggs, (*1*) in different periods during the time of laying of the same hen, and (*2*) on hens of different breeds.

In the Women's Section some interesting papers will be given upon woman's sphere as an instructor in poultry-keeping, and the charge of small animals. This will be considered as a home industry for women. Among papers dealing with breeding, visitors will hear an account of American methods of packing and marketing. In the section of hygiene, matters

relating to diseases of poultry will be discussed, American methods of combating disease, French investigations in tuberculosis of poultry, and the infection of eggs dead in the shell. In the educational section, administration of agricultural clubs and farm schools will be treated exhaustively.

The Congress can be attended by delegates representing any Government, Teaching and Research Institution or Organisation engaged in some phase of poultry breeding, production or distribution. Private individuals interested in these subjects may also attend. Inquiries should be addressed to the Hon. Secy. of the British Congress Committee, 8, Vincent Square, Westminster, London, S.W. 1.

The Use of Fish Meal for Pigs: A Warning Note.

FISH meal, rightly used, forms a palatable food for stock, but the Ministry is receiving evidence that farmers are not using this material with proper discretion. Pork butchers and bacon curers are complaining bitterly that many pigs bought by them are tainted with a fishy taste and odour, and the carcasses from such pigs are worthless for human food. In all these cases, when the trouble is traced back, it appears that the feeders have used either the wrong brand of fish meal, or have used it in excess, or, in certain cases, have used a proprietary pig meal containing a large quantity of fish meal. It cannot be too strongly emphasised that fish meal is a dangerous food for pigs unless the right grade is used and unless this meal does not form more than one-eighth of the dry food fed. An error in this direction is very difficult to correct, since the fishy taint once acquired by the pig is very difficult to get rid of subsequently. It is certain that butchers will not face the possibility of loss through acquiring tainted carcasses, and the inevitable result of misuse of fish meal for pigs will be that butchers may refuse to buy pigs which have been fed on fish meal. The Ministry's Leaflet No. 333 gives particulars of the kind of fish meal that is safe and the quantity that can be used; unless a farmer can ensure that instructions of the kind are followed he had better let fish meal alone.

Note for Compound Meal Manufacturers.—The Ministry has recently been advised of a case of tainting of pig meat which occurred in the Birmingham area. The case concerned a lot of 500 pigs, the carcasses of which were yellow and oily in appearance and had a strong fishy odour. On tracing this case back to its source, it appeared that the tainting was due to the

presence of considerable quantities of fish meal in a patent pig meal fed to the pigs. The Ministry wishes to call the attention of manufacturers to the danger of putting large quantities of fish meal into meals or cakes; "white fish meal" only should be used for this purpose, and the quantity fed should not exceed one-eighth by dry weight of the total meal. In all such cases, when a meal contains fish meal, it is advisable to state the proportion by weight of fish meal present to obviate the danger of the pig feeder using fish meal in excess by feeding fish meal in conjunction with such pig meals.

The danger of taint from such source is a real one, and misuse of fish meal is liable to discredit the value of fish meal as a feeding stuff. It is obvious that the retail meat trade will take as strong action as possible to avoid losses in the future from such a source if such cases occur in any frequency.

Foot-and-Mouth Disease.—*Gloucestershire, Herefordshire, the Midland Counties Group, and Lincolnshire (Ormsby and Grimsby Districts).*—All restrictions imposed in connection with the outbreaks in these districts have now been withdrawn.

Yorkshire (East Riding).—Six outbreaks, in all, have been confirmed in the Halsham district, the most recent being on the 1st March on premises in close proximity to those concerned in earlier outbreaks. The restrictions on movement are applicable only to ten parishes, in the immediate neighbourhood of Halsham, and the parish of Hollym alone remains a prohibited area, that is, an area in which movement is entirely prohibited except by licence.

Rabies.—*Wiltshire, Dorset and Hampshire.*—One further case of Rabies has occurred in this district since the issue of the March *Journal*, namely, on the 12th March at Southampton.

The limits of the Inner Controlled Area around Salisbury have been contracted by the issue of an Order which operated on the 15th February. That Area now includes only the Borough of Salisbury and 7 parishes immediately surrounding the Borough.

Glamorgan.—No further outbreak has occurred in this district.

Berkshire District.—A case was confirmed at High Wycombe on the first of March in a puppy which died and was buried early in January.

London.—The suspected case of Rabies in the Borough of Woolwich having been found, as the result of inoculation experiments, not to be one of Rabies, the restrictions on the movement of dogs out of a portion of that Borough were withdrawn as from the 4th March. No further outbreak of Rabies having occurred in the Acton District since that which necessitated the imposition of restrictions on the 8th December last, the requirement of leading was, therefore, withdrawn as from the 4th March.

**Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.**

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 2.

MAY, 1921.

NOTES FOR THE MONTH.

Home-Grown Wheat Prices.

An account was given in the March issue of this Journal (p. 1097) of the arrangements proposed to give effect to the Government's decision in regard to the price to be paid for home-grown wheat of the 1920 crop. The scheme has since been extended so as to enable sales made by growers to merchants between 8th November, 1920, and 5th March, 1921, to be dealt with more effectively. Farmers who sold wheat during this period to merchants can now claim the repayment of the difference between the price which they received and the prescribed price for wheat of sound milling quality. Claim forms containing instructions to growers in England and Wales can be obtained from the local branches of the National Farmers' Union and the National Association of Corn and Agricultural Merchants.

* * * * * *

Home-Grown Wheat Prices for April and May.

In connection with the arrangement as regards the price of home-grown wheat of the 1920 crop, it was stated that the price of 95s. per 504 lb. for home-grown wheat of sound milling quality will continue so long as the average c.i.f. cost of imported wheat remains above the parity of that figure. This average will be the average of the c.i.f. cost of all milling wheat imported during the two preceding months, together with the actual and anticipated arrivals in the United Kingdom during the current month, subject to adjustment in respect of the lower percentage of flour of equal water content obtainable from home-grown wheat as compared with imported wheat. In the event of this average falling below the equivalent of 95s. the price of home-grown wheat will be adjusted accordingly, and the revised price to be paid by millers will be announced monthly.

The Ministry announced on the 23rd of March that it had been informed by the Ministry of Food that the average c.i.f. cost of imported wheat calculated as stated above for the month of March was 102s. 7d. per 480 lb. After making the necessary adjustment for moisture content, the equivalent price for home-grown wheat is approximately 96s. 3d. per 504 lb. The price of 95s. per 504 lb. payable by millers therefore remained unaffected during the month of April.

As regards the price payable during the month of May, the Ministry is informed that the Royal Commission on Wheat Supplies calculate that the cost of wheat imp rted during February, March and April is equivalent to 92s. per qr. of 504 lb. for home-grown wheat of sound milling quality. For the month of May, 1921, therefore, the average price properly receivable by growers will be 92s. per 504 lb.

Special arrangements have been made which should enable millers to use home-grown wheat freely and to pay for it on the average a price not less than the price properly receivable by growers for wheat of average quality. Choice samples should realise prices above the average, but lower prices can only be expected for samples of inferior quality or condition.

No definite guarantee can of course be given that millers will be able to purchase all the home-grown wheat that may be offered to them at any given time, especially if farmers press their wheat on the market in excess of normal requirements, but the Ministry does not doubt that the whole of the wheat crop is required and that it will have been absorbed by the mills by 13th August next, the date at which the present arrangement will come to an end.

* * * * * *

Export of Worn Out Horses.

MANY complaints have lately reached the Ministry from those who have seen or heard that British horses landed in Belgium are too often in a condition that should have precluded their export. For some time past the Ministry has been conducting a very careful investigation into conditions in Belgium and at our home ports, and as a result it was ascertained that while the standard at the Port of London is uniformly high, certain cargoes which have been allowed to leave provincial ports have contained horses which in the Ministry's opinion did not conform to the standard set up by the Act of 1914. In order to secure the greater supervision which is necessary in order to maintain humane conditions, it has been decided to employ an additional Staff of Veterinary Surgeons who will give their whole time to this work.

It is very generally admitted that the Act of 1914 has to a large extent removed from export the class of horse that made up a very considerable part of the consignments before the War, and it is hoped that the fresh action taken will still further secure the observance of the Act. Every effort is being made to stimulate the slaughter by humane methods on this side of horses that are intended for meat. It is proposed to extend this system to the fullest possible extent so that no horse intended for consumption may be sent across the seas alive. The extent to which horse-slaughtering depôts in this country have developed near the ports during the past six months is most encouraging and favours the belief that home-killing will soon become the rule and the export of live horses for meat a rare exception. At the same time it is well to remember that a horse in all respects fit for work may be bought in Belgium for meat, because horses are sold in the open market and the butcher may be prepared to outbid other buyers.

A Successful Prosecution under the Swine Fever Order.

IN Glasgow last month a pig feeder was charged and found guilty of having had in his possession a number of pigs affected with or suspected of having Swine Fever and failing to give notice of the outbreak to the authorities. He was further charged and found guilty with having exposed twenty pigs for sale in one market and fifteen pigs for sale in another market, all these pigs being diseased or suspected of being diseased. Nearly all the pigs disposed of in the markets had died of Swine Fever within a short time of the sale. The Court imposed a fine of £100 with two months' imprisonment as an alternative. The Ministry of Agriculture through its inspectors has traced the pigs that this dealer sold, and of the fifteen sold on the 8th December all were suffering from Swine Fever ten days later. The twenty sold on 6th December were disposed of to different farmers and introduced Swine Fever on eight sets of premises. The very serious injury which is done to the pig breeding industry by cases of this sort will be realised, and it is the duty of every pig keeper to see that he does not sell any animals which afford any suspicion of the existence of Swine Fever. In this trade as in all others there is a certain amount of wilful carelessness, even of fraud, but if the Petty Sessional Courts before which cases like the one referred to above are brought, will only deal with them on the same salutary lines it

is safe to say that the business of trading suspect animals will become unpopular.

Building for Land Settlement: A Survey of the Ministry's Work.

EARLY in April Sir Lawrence Weaver, Director-General of the Land Department of the Ministry of Agriculture, read to the Royal Institute of British Architects a paper in which he set out a brief record of the Ministry's work in providing land settlement for ex-soldiers. He pointed out that this work is the outcome of a pledge given during the war to men in H.M. Service and to women who worked on the land for at least six months. This pledge received statutory force from the Land Settlement (Facilities) Act of 1919.

The total applications from ex-Service men for land amounted to 48,340 when the list was closed on December 1st last. It is expected that about 30,000 of these applications will stand and of these upwards of 11,000 have been satisfied. If agricultural conditions continue satisfactory enough to maintain the pressure of applicants' demand for land it may be found necessary to acquire as much as 160,000 acres more, so that when the work comes to an end 640 square miles will have been acquired and 30,000 men will have been settled.

The term "Small Holding" is an elastic one and covers anything between a plot of an acre or two suitable for a market garden up to a fifty acre dairy holding with seven roomed cottage, dairy and farm buildings. The capital cost has ranged from £100 to £5,000, but is now limited to £2,500. The average size of a holding in England and Wales is about 13½ acres. Practical difficulties in the way of work done have been immense. Demobilisation brought no reduction in the cost of building; contrary to general expectation prices increased. Although the Land Settlement (Facilities) Act placed twenty million pounds to the credit of capital costs and although the Government undertook to meet all annual losses, the most rigid economy has been called for all the time. Approximate scales of capital cost and annual loss per holding were placed before the County Councils in the summer of last year, and the Ministry's superintending architects review all small holding building schemes and cut out every item of unnecessary expenditure.

The Land Settlement Division maintains the closest

relationship with County Councils, and the Ministry's District Commissioners act with the superintending architects "as ambassadors to the County Councils." Experience has shown that cheap architects make poor buildings, and the Ministry urges upon County Councils the engagement of men with proper qualifications. In view of the bitter need for reduction in cost, it has been found that the architect in charge of cottage and farm building schemes must needs be more of an organiser and economist than an artist. The complete task of the Ministry which is, working through the County Councils, to provide three thousand new cottages and nearly two thousand sets of new farm buildings, in addition to hundreds of adaptations of existing premises, is complicated by the fact that the work is spread over sixty-two administrative counties "in remote Yorkshire vales, on the slopes of Welsh mountains, in the folds of inaccessible downs." The whole of the architectural work has been carried on as far as the Department is concerned by less than fifty people and the best possible use has been made of the very limited range of available material. In building operations it has been found that brick has held its own, though most exhaustive experiments have been made with cob, pisé and concrete.

The Ministry looks forward to the time when it will no longer need to control directly the building operations on its own Farm Settlements, which amount to 25,000 acres. It takes the view that building is a commercial business associated with a speculative side and carrying with it risks that a Ministry ought not to undertake. A Government Department is concerned with administration and not with trade, nor can it hope to carry on business successfully because the Treasury supervision, which is absolutely essential in the best interests of the State, enforces delays and difficulties which the ordinary building contractor does not encounter. This view is explained in greater detail in the Report of Proceedings under the Small Holdings Colonies Act for the period ended 31st March, 1920, in which it is explained that a decision has been arrived at:—

(a) To divide into small holdings the area now devoted to central farms on small holdings settlements, and to dispense with the services of the Director so soon as the equipment of the whole estate for small holdings purposes has been completed and the settlers are fairly established.

(b) To transfer the management of such estates to the Councils of the counties in which they are situate.

(c) To deal with the profit-sharing farm settlements in one of the following ways: (1) Where the land is suitable, by cutting up part of the estate into small holdings, and by selling the remainder as ordinary farms; (2) By selling the complete estate; (3) By retaining one, or at most two, specially favourable estates (in whole or in part) in order to draft thereto men displaced on other estates.

Rations for Live Stock.

No. 32 of the Miscellaneous Publications of the Ministry is by Professor T. B. Wood, of Cambridge University, and is called "Rations for Live Stock." It shows the composition and nutritive value of many feeding stuffs, the relation between live-weight and food requirement, and offers the farmer a method of working out suitable rations for his animals. Professor Wood compares an animal with a steam engine at work and points out that it must be supplied with the materials necessary for fuel and repairs, the fuel of the animal being carbohydrates and fats or oils, while the repairing material is given in the form of albuminoids or flesh formers. He emphasises the important fact that the value of the feeding stuff depends on the proportion that can be digested, and the pamphlet contains figures giving the nutritive value of a large number of foods and the nutritive ratio of the repair to the fuel content. Then comes the question of productive feeding—the food that will enable animals to increase their weight, yield more milk or do more work. Advice is offered on the question of buying feeding stuffs, and figures are supplied giving the best measure of the relative productive value of various concentrated foods.

An important section of the pamphlet is that dealing with the general properties of feeding stuffs. It is followed by notes on the rations for fattening bullocks, for cows, calves, sheep, horses and pigs. Professor Wood has used the simplest possible language and has been so careful to explain the principles underlying the tables accompanying the pamphlet that a very small effort is required to master them. The value of these contents to the practical agriculturist is undoubtedly very great. Even some of our successful stock owners may find in the light of this work that they have been feeding wastefully and that a better balanced ration may add to the worth and condition of the stock fed.

Minimum Prices for Wheat and Oats Harvested in 1921.

THE procedure in regard to the minimum prices guaranteed by the Agriculture Act, 1920, in respect of wheat and oats produced in 1921 was explained in the April issue of the JOURNAL (p. 8). The attention of farmers is drawn to the fact that no payment will be made unless a claim is made in respect of the area on which the wheat or oats have been produced. Forms of claim for 1921 will be issued along with the forms on which the Agricultural Returns have to be made on 4th June, 1921. The claims must be forwarded direct to the Ministry of Agriculture and Fisheries not later than the 30th June, unless the claimant can show that he became the occupier of the land after that date, in which case the Minister may accept a claim made not later than the 1st September, 1921.

The claimant will be required to enter on the form of claim particulars of each separate field of wheat or oats. The number of each field as shown on the 25-inch Ordnance Survey Map, and the ploughed area of wheat or oats in each field, will have to be stated. These detailed particulars are necessary to enable the Ministry and the County Agricultural Committee to verify the accuracy of the claim.

Copies of the Ordnance Survey Map on the 25-inch scale can be purchased through any bookseller, price 5s. per sheet. In most districts copies of the map of the district can be inspected at the office of the County Agricultural Committee. Information as to the number of fields can also be obtained at the local office of the District Valuer of the Board of Inland Revenue. The Assistant Overseer may also possess a copy of the map of his parish. In case of difficulty, inquiry should be made of the Cultivation Officer of the County Agricultural Committee. Farmers are advised to take steps forthwith to ascertain the numbers of the fields sown or intended to be sown with wheat or oats as shown on the 25-inch Ordnance Survey Map.

ACCOUNTS OF A HAMPSHIRE DOWN FLOCK.

SIR A. D. HALL, K.C.B., F.R.S.

IN this JOURNAL for May, 1920, the accounts of the Pedigree Hampshire Down Flock belonging to the Lord Wandsworth Orphanage and kept on their Long Sutton Estate in Hampshire were set out for the year ending Michaelmas, 1919. Below are set out the corresponding figures for the following year, ending Michaelmas, 1920.

Cr.

1919, 11th Oct.	£ s d.	£ s. d.	*1918/19.* £ s. d.
To Capital a/c 11th Oct., 1919—			
261 Ewes at £4	1,044 0 0		
4 Rams at £7	28 0 0		
Half cost purchased ram ..	78 15 0		
Cost hired ram .. .	52 10 0		
Keep, May 1st, Oct. 11th ..	583 0 0		
69 Ewe Lambs / 20 Ram Lambs } at cost on May 1st	760 11 0		
Keep, May 1st, Oct. 11th ..	206 6 8		
		2,753 2 8	2,812 16 4
Labour		537 8 0	405 13 5
Horse Labour		87 19 6	88 4 6
Purchased foods consumed		1,462 0 11	662 8 9
Roots, Vetches, Kale, etc., consumed, at cost		977 19 8	673 16 7
Fields grazed, at cost		139 13 6	74 9 0
Hay consumed, at market price £13, plus tying 5/2d.		566 10 8	402 16 8
Oats, Beans consumed, at market price		160 10 7	295 7 2
Sundries		204 4 7	161 11 9
Management and other general expenses		250 0 0	256 3 5
Ram lambs purchased (3)		435 15 0	157 10 0
Ram Lamb hired		52 10 0	52 10 0
Pedigree Suspense a/c. 1/3 Cost 40 ewes. ½ Cost 1 Ram.		321 19 11	
		7,949 15 0	6,043 7 2

Dr.

1920.		*1919/1920.* £ s. d.	*1918/1919.* £ s. d.
By Ram Lambs Sold (73)		1,776 2 7	903 16 4
Fat Sheep and Lambs (146)		895 1 4	1,108 0 5
Shearlings (20)		374 14 2	255 7 6
Wool, 2,395 lb. at 39½d.			
322 lb. Lambswool at 44d.			
417 lb. Tarlings at 5d.		452 7 5	326 18 10
Manurial Residues		537 4 7	335 7 2
Sundries..		60 10 2	36 2 6
Pedigree Suspense a/c. ½ cost Rams		217 17 6	
Valuation, 11th Oct., 1920—			
263 ewes at £4 on May 1st, plus cost of keep to Oct. 11th	£1,170 10 0		
Cost hired Ram	52 10 0		
½ cost 3 Ram Lambs ..	217 17 6		
3 Rams at £7	21 0 0		
16 Rams Lambs / 90 Ewe Lambs / 47 Tegs } at cost	1,983 6 0		
		3,445 3 6	2,753 2 8
Loss..		190 13 9	324 11 9
		7,949 15 0	6,043 7 2

It may be explained again that the accounts are kept on a costs basis. The initial valuation is arrived at by taking the number of flock ewes on 1st May (approximately the date of weaning) at the average figure of £4 each. Old rams are similarly valued at £7 each. From 1st May the cost of keeping (a) the ewes, (b) the selected ram lambs, (c) the ewe lambs and wethers is kept separately, and the valuations at Michaelmas are made up of the flock ewes at their fixed £4 price and the cost of keep between 1st May and 11th October, any ram lambs remaining unsold at cost, also ewe lambs and tegs at cost. The valuation figure has also to include the cost of any rams hired for the coming season, and one-half cost of rams purchased. For book-keeping purposes a pedigree suspense account is kept which is debited with the cost of ewes and rams purchased for the flock. one-half of the ram costs are charged to the flock in each of the two years after purchase, and the cost of the ewes is similarly spread over three years. The labour and horse labour items represent actual costs; the crops that are folded off are charged at two-thirds of the cost of cultivation, plus the cost of seed (the manures and one-third of the cultivation, as representing cleaning costs, are passed on to the succeeding corn crops); hay, oats and other foods grown on the farm are charged at market prices.

An examination of the figures for the two years shows that the costs of keeping the flock, high as they were in 1918-19, have been greatly increased in 1919-20. The cost of the labour directly employed upon the flock (one head and one assistant shepherd and one labourer) has increased from £406 to £537. Similarly the cost of the crops consumed, again largely labour, has increased from £673 to £978. The chief increase in the expenditure comes, however, in the purchased foods, the cost of which has risen from £662 to £1,462. To some extent this has been due to a large number of lambs raised and to increased prices, but the extra cost has been chiefly due to the fact that during the year in question feeding stuffs were again obtainable in quantity and were consumed on the principle of "no stint" and "the best is good enough for me" which prevails in the rearing of pedigree stock. Less home grown oats and beans were used, the grazing (92 acres of lattermath) on the other hand cost rather more, but this cost is accidentally swelled by a very heavy bill for fertilisers charged to the pastures, on which a course of improvement is being carried out. Less hay was consumed, but at the price then ruling, £13, the cost amounted to £566 as compared with £402 in the previous year.

The general result is a very heavy expenditure; taking the ewe as a unit the total cost of the flock per ewe amounted to £16 8s. in 1919-20 as compared with £9 5s. in the preceding year. Of this £10 12s. went for food, £2 8s. for labour, £1 8s. for rams, &c., £1 15s. for management and sundries, as compared with £5 15s. for food, 26s. for labour, 17s. for rams and 27s. management and sundries in 1918-19. These figures are very large in themselves, apart from the enormous increase they show on those of the preceding year. To some extent the increase is due to a bigger number of lambs reared, 304 against 278, and particularly a bigger number of ram lambs which cost the most, 89 against 58 in the preceding year. Labour and food were dearer. The extra 8s. per ewe for sundries represented only the increased cost of showing in 1920 as compared with 1919. Big as the food bill appears it is not a wasteful one, such as might be incurred by a shepherd who dips at will into granary and cake store; the foods are rationed out after discussion between the manager and the shepherd, and while there has been no stint there has been no waste. I am satisfied that the costs are legitimate enough for the year and do not exceed those prevailing in other pedigree flocks of the same quality.

Of course there are probably no other sheep so expensively produced; Hampshire ram lambs have to be forced from birth, indeed as much as possible before birth, because neither breeding nor quality will be of much avail if the lambs have not size at the August sales. The essence of a Hampshire is early maturity and the ram buyers make their choice on what they see before them, which is, other things like conformation and wool being equal, the weight attained in the time, whether that is due to skilful feeding and to natural capacity to put on flesh such as may be transmitted to the offspring. I am aware of few pedigree flocks that have a strict account kept against them, especially as they so often are kept as hobbies; indeed, the main purpose of setting out this account is to induce owners of pedigree flocks to realise what expenditure they are up against.

On the credit side the flock makes a better showing in 1919-20 than in the preceding year. In the first place more lambs were reared, 310 from 268 ewes, as against 278 from 279 ewes in the preceding year, and the quality was better, so that 89 could be drafted for the ram sales as compared with 58 before. Sales were better; as is well known, there was an exceptional recovery in the demand for rams and sheep of all kinds in 1920. This

flock in 1920 let two lambs at 225 and 150 guineas respectively. and sold three others at 82, 54, and 48 guineas, the average for 78 lambs being over £24, while the 20 shearlings averaged nearly £19 each. The draft ewes and the butcher's lambs made over £6 each as compared with 73s. in the previous year. The wool, of which the ewes clipped over 8 lb. and the lambs under 3 lb., produced £452, as against £327. The valuation of the flock shows a considerable rise, nearly £700, but this was not due to any writing up of the value of the ewes, which would have been done in an ordinary valuation according to market prices, but to the fact that 47 tegs had not been sold by the 11th October (afterwards realising £306), that there were 11 more flock lambs kept over, and that the pedigree costs for rams hired and purchased had been increased by £140, and that the cost of keep from 1st May had been greater.

The final result shows a loss of £190, a sufficiently disconcerting result for what had seemed to be a good year, when the fall of lambs had been good, the early spring favourable, and the sales both in amount and quality far better than the flock had hitherto realised. Of course the loss could be converted into a profit if the hay, charged at market price—£13, were charged at cost, *i.e.*, at something under £4. Then the debit of £566 would become £176. In the oats and beans bought from the farm is also concealed a little profit. If all the home grown foods were charged at cost the account would show a nominal profit of £250 instead of a loss of £190. Argument will of course be perennial whether it is more correct to charge the live stock at cost or market price for home grown foods; it does not matter much except in times like the present when market prices are fluctuating widely The important thing is that the farmer, using his book-keeping for his own information, should not deceive himself. The final upshot of the accounts of this flock, whether home grown food is taken in at cost or market price, comes to the same thing, viz., the flock produced from 171 acres of arable land cropped with roots, vetches, &c., 40 acres of seeds as hay, 8 acres of oats and beans, and 92 acres of lattermath, a cash return of about £250 after all expenses had been paid. The flock is only valued at about £3,000 at Michaelmas, but taking the average of the net expenditure also standing against it throughout the year it ought to be paying interest on a sum of about £5,000 floating capital. The result then could be summed up as showing that the flock returns a bare 5 per cent. on its capital while the land which the flock used, some 220 acres, earned no profit at all.

Now the land under corn on the same farm that year made an average profit of £4 12s. an acre, and it is in the light of this figure that the really unprofitable nature of the flock is seen. Land which will produce a profit of £4 12s. an acre under corn will produce no profit at all but only a low rate of interest on the extra capital at stake when its produce is marketed in the form of a pedigree flock.

It may be urged that the corn could not be grown but for the sheeping the land had received. The proposition is debatable, but at any rate the flock gets ample credit for what is done in this direction, because the subsequent crops have to pay off some £3 an acre of manurial residues in addition to £2 an acre or so of cleaning costs. While there can be no doubt about the enrichment of the soil effected by the heavy cake and corn feeding accompanying its folding over by a pedigree flock it is often difficult to get a paying return for this manuring. If the fold is late in March or even February, it is often difficult to get spring corn sown on a satisfactory tilth in time to secure a good crop, one that is in any way proportional to the manure residues supposed to be in the land. On these chalk soils the spring drought may set in early, and the two dominant factors in securing a good crop are early sowing and a good tilth. Actually on this farm wheat is the profitable crop rather than spring oats and barley, because it does not suffer from the late tilth and has not to pay so much of the costs carried over from the folding. In fact the corn is most profitable on the land that is never sheeped.

Another objection may be taken to the general conclusion as to the unprofitable nature of the flock—that it is not quite big enough nor skilfully enough managed to attain the results that alone will pay for the expense involved. The prices realised for pedigree rams by a flock which is recognised as among the two or three leading flocks in the country, the sort of flock which wins first prizes at the Royal Show, are very different from the prices obtained by a flock which just misses the highest position. Such a position has not been attained by this flock, whose show record for 1920 was one third prize at the Royal Counties Show, two second and two third prizes at the Bath and West Show, and one second prize at the Hampshire Down Society's Breed Show. The truth of both objections may be admitted. A flock of 400 or 500 has a much greater chance of winning prizes than one of 200, merely because there are more to select from. The expenses increase with

numbers but the whole average of the sales may be increased by the superior prize winning capacity. Again prize-winning to a considerable extent depends upon the art with which the stock are finally prepared and presented for show, and in connection with every breed there are two or three shepherds known for their personal skill in putting their animals before the judge to the best advantage. However, let it be admitted that the flock in question may fail in this respect, the general conclusion would still emerge that ram breeding is an unprofitable business unless the flock can be brought to the very top of the tree.

In fact one cannot standardise a ram breeder's business and prepare an account which compares the average cost of production with the return for the output that may be expected in a normal market. On the receipt side of the account the personal factor counts for much; how well can the particular shepherd show his sheep, how clever a salesman is the owner in the special and limited market in which he had to make his profit. But these accounts do show what costs of production have to be faced and how unprofitable a business ram breeding is likely to be for the majority of men who engage in it. The balance sheet may serve the purpose of inducing ram breeders to consider their business in the light of results; can they so bring their flock to the front as to pay for the expenditure or is the loss worth while as a luxury?

RESEARCH IN ANIMAL BREEDING.

II.

R. C. PUNNETT, F.R.S.,
Professor of Genetics, University of Cambridge.

In the first article of this series, published in the April issue of the JOURNAL, *Prof. Punnett dealt with coat colours in cattle as an illustration of simple Mendelian inheritance.*

IN the case selected for illustrating simple Mendelian inheritance, viz., black and red coat colours in cattle, one of the members of the alternative pairs of characters is completely dominant to the other. The black animal that carries red germ cells is quite as black in appearance as the true breeding black that carries black germ cells only. This feature of complete dominance is found frequently in animals, but there are other cases in which it is possible to distinguish by appearance, the form that carries both kinds of germ cells. Roan Shorthorns provide an illustration.

No breeder has succeeded in establishing a strain breeding true to roan, for such animals, when bred together, always throw reds and whites in addition to roans. Statistical examination of the herd books by several writers suggests that two kinds of germ cells are concerned, viz., " red " and " white." When two " red " germ cells meet, a red* animal results, and such animals breed true to red; also, when two " white " germ cells meet, the result is a white, and such animals breed true to white. When, however, a red is crossed with a white, as shown in Fig. 3, a union is effected between a " red " and a " white " germ cell. The resultant animal is a roan, more or less intermediate in appearance between full red and white. This animal, formed by two unlike germ cells, carries both " red " and " white " germ cells in equal numbers: consequently, when roans are mated together equal numbers of " red " and " white " ova are fertilized by equal numbers of " red " and " white " sperms. Each red ovum has an equal chance of being fertilized by a " red " or by a " white " sperm; in the former case it will give a pure red animal, and in the latter a roan. Also, each " white " ovum has an equal chance of being fertilized by a " red " or " white " sperm; in the former case a roan animal will result, and in the latter a white. Roans mated together, as shown in

* Both reds and roans may have white markings, especially on the belly, but these appear to be independent of the roan character.

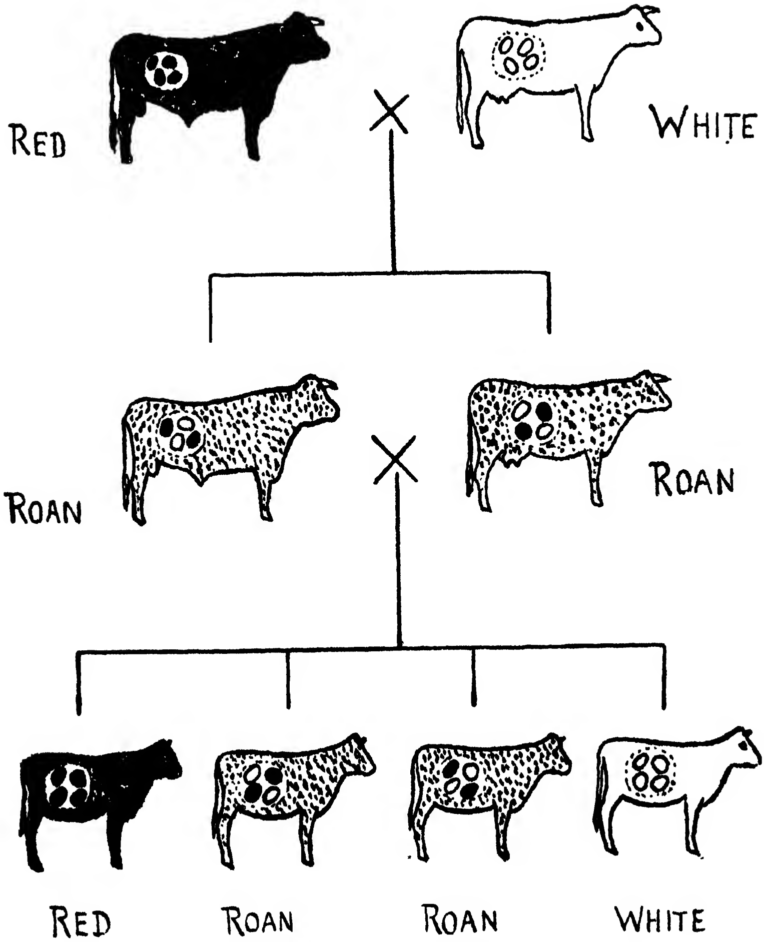

FIG. 3.—Illustrating the relations of Red, White and Roan.

Fig. 3, give reds, roans, and whites in the ratio 1 : 2 : 1. From the view of the practical breeder a roan animal is a hybrid between red and white; the colour cannot be fixed, for there are no " roan " germ cells (only " red " and " white " cells). The breeder who desires roan animals will be well advised to obtain them by crossing red with white; in this way 100 per cent. of roans will result, as against 50 per cent. from mating roan by roan, roan by red, or roan by white.

The " breaking up of the type " that often occurs after a cross is a familiar feature to breeders. The first cross animals may show considerable uniformity, though differing from both parental strains. In one character they may take after one parent, in another they may resemble the other parent, while in a third they may be more or less intermediate between the two. When such animals are bred together a great diversity of forms makes its appearance in the next generation, and in extreme cases scarcely any two beasts may be alike. The skilled breeder,

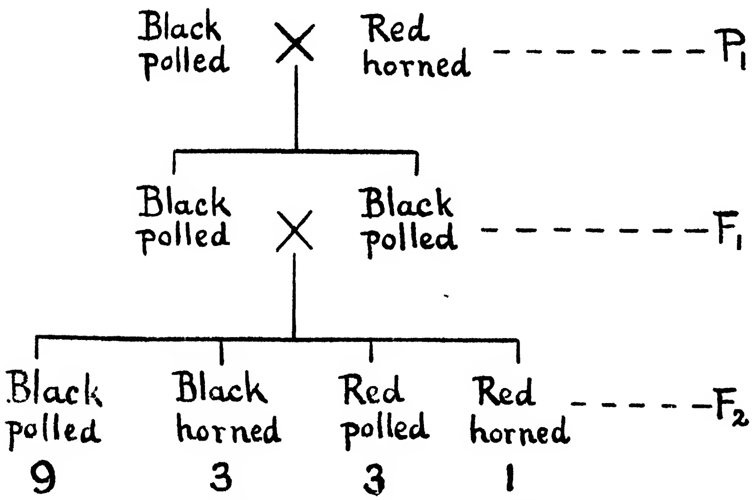

FIG. 4.—Illustrating the relations of Polled and Horned cattle.

however, will often name with certainty the original parental breeds of such a mixed progeny, as he will understand that there is something orderly underlying apparent chaos. The breeder who sees as far as this will doubtless welcome the simple explanation that Mendelism affords, but for those who may doubt the possibility of such an explanation, a simple example is given to illustrate the nature of the principle involved.

Suppose a cross is made between a black polled and a red horned breed. The progeny will be black polled animals (see

Fig. 4). The F1 generation is uniform, but when a further generation is raised from these, fresh types appear. In addition to black polled and red horned beasts there will be horned blacks and polled reds, types distinct both from parents and grandparents, but evidently a recombination of characters found in the grandparents. These four types appear in widely different proportions, as indicated by the numbers in Fig. 4. It has been pointed out already that polled and horned cattle form a pair of alternative characters, of which polled is dominant; and that black and red form a similar pair, the black being dominant. Knowing this, we should expect all the F1 beasts to be both black and polled; the F2 generation to consist of blacks and reds in the ratio 3 : 1, and polled and horned in the same ratio. If we suppose that the factors for the black-red and the polled-horned pairs are transmitted in the same manner, *but independently of one another*, we must obtain a F2 generation consisting of the four classes black-polled, black-horned, red-polled and red-horned in the ratio 9 : 3 : 3 : 1. This is the only ratio in which the polled and horned appear in the proportion 3 : 1, and the blacks and reds simultaneously in the same proportion, provided that each pair is inherited independently. Though the ratio 9 : 3 : 3 : 1 has not been verified on a comprehensive scale for the cattle cross, it has been worked out in all details in many cases for smaller animals, where the expenses of breeding are far less. There is reason for supposing that if a F2 generation of several hundreds of cattle were bred from this cross, the four classes mentioned would be obtained in the proportions given above.

There has been a " break-up " of the parental types in that the two new classes, horned-blacks and polled-reds appear in the F2 generation; and it is clear that these new classes arise through recombination of the two pairs of factors in which the original parents differed. The " break-up," however, is not marked, because the parents differed in two pairs of factors only. Had they differed in ten pairs, the F2 generation would have been very much more complex, and the feature of recombination, so obvious in the simpler case, would have been obscured by the great number of recombinations that would have appeared. Nevertheless, on the evidence obtained from smaller animals, there is good reason for supposing that the more complicated case could be resolved on the same lines as the simpler one, and that the same principle underlies both.

A cross may be undertaken deliberately with the idea of combining particular characters found in one breed with other cha-

racters found in another breed, and with this in view it is clear that Mendelian principles can be of great assistance to the breeder. Let us suppose that the breeder wishes to obtain a strain of red polled cattle out of Aberdeen Angus and Red Shorthorn; and further, that he is not aware of the fact that polled and horned, and black and red behave as simple Mendelian pairs. From this crossing only polled blacks result. So far he can say only that the Angus is prepotent; but as soon as he raises a F2 generation and views it in the light of Mendelian knowledge, he begins to understand what is happening. The fact that he gets no intermediates, but only blacks and reds in the F2 generation, and that the latter form about one quarter of the total, tells him that these colours depend upon a single pair of factors. From the point of view of horns in the F2 generation, it will be noted that polled and horned appear in the ratio 3 : 1; and this tells the breeder that he is dealing with another pair of factors. Moreover, the 9 : 3 : 3 : 1 ratio tells him that the two pairs are transmitted independently; for this is the meaning of the 9 : 3 : 3 : 1 ratio in analysing the phenomena of heredity.

Having obtained the polled reds the breeder wants to fix them in the shortest time. To a problem of this sort Mendelian theory may be a valuable guide. When once the factors concerned in a cross have been determined, it is possible to calculate the proportion of fixed animals in each class of the F2 generation, and to suggest also how they are to be found. In explanation we may examine the cattle cross from a slightly different point of view. The nature of the F2 generation tells us that we are concerned with a difference of two pairs of factors, viz., the pair for polled and horned denoted by *P* and *p*, and the pair for black and red, *B* and *b*.* It is clear that both dominants went in with the Angus and both recessives with the Shorthorn: therefore, we denote the polled black as *PPBB* and the Shorthorn as *ppbb*. Since the F1 gets *P* and *B* from its Angus parent, and *p* and *b* from its Shorthorn parent, its constitution must be *PpBb* (Fig. 5). When F1 forms germ cells each cell contains a representative of the *P*-*p* pair, and also a representative of the *B*-*b* pair. Hence 50 per cent. contain *P* and 50 per cent. contain *p*; also 50 per cent. contain *B* and 50 per cent. contain *b*. Since the F2 generation shows that the *P*-*p* pair and the *B*-*b* pair are transmitted independently, we must suppose that any germ cell containing *P* has an equal chance of containing either *B* or *b*, and similarly, any *p* germ cell has an equal chance of containing *B* or *b*. Hence

* It is customary to denote the factor that gives rise to the dominant of a pair of alternative characters, by a capital letter, and that upon which the recessive depends, by the corresponding small letter.

Black polled	Red horned
PPBB	ppbb
forms germcells	forms germcells
PB PB	pb pb
PpBb	PpBb
Black polled	Black polled F_1
forms germcells	forms germcells
PB	PB
Pb	Pb
pB	pB
pb	pb

giving rise to an F_2 generation:—

1. PB PB Black polled	2. PB Pb Black polled	3. PB pB Black polled	4. PB pb Black polled
5. Pb PB Black polled	6. Pb Pb Red polled	7. Pb pB Black polled	8. Pb pb Red polled
9. pB PB Black polled	10. pB Pb Black polled	11. pB pB Black horned	12. pB pb Black horned
13. pb PB Black polled	14. pb Pb Red polled	15. pb pB Black horned	16. pb pb Red horned

FIG. 5.—Illustrating the relations of Aberdeen Angus and Red Shorthorn.

the F1 animals will produce the 4 kinds of germ cells *PB*, *Pb*, *pB* and *pb*, and produce them in equal numbers. When F1 beasts are mated together it means that we are bringing together a series of ova of this nature with a similar series of sperms. The simplest way to arrive at the result is to make a figure of 16 squares, as shown in Fig. 5, and to write the above series of germ cells first across the four horizontal rows of the figure, and then down the four vertical rows of the same figure. This will give all the different possible combinations in the proportions in which they may be expected to occur, *i.e.*, the constitution of the F2 generation. Examination of the squares shows that 9 out of the 16 contain both *P* and *B* and are, therefore, polled blacks, 3 contain *B* and *p*, which are horned blacks; 3, in which *P* is associated with *b*, are polled reds; while 1, having only *b* and *p*, must be red horned. The three red polled are not all alike. One is *PPbb* and two are *Ppbb* (Fig. 5, squares numbered 6, 8, and 14). The former is pure for the polled factor, having received it from both parents; the others, however, have received it from one parent only, and are consequently impure. The polled character is already fixed in one-third of the red polled F2 beasts, but how are the fixed to be distinguished from the unfixed beasts? As pointed out in the previous article, this can be done by crossing with the recessive, which in this case is the horned beast. The fixed polled red *PPbb* gives only polled beasts when mated with horned animals, the impure polled red *Ppbb* gives on the average equal numbers of polled and horned. The above example was selected as a very simple illustration of the manner in which the "break-up" of the type, and the recombination of characters is interpreted on Mendelian lines, but the general principle applies to far more complicated cases. It has provided us with a simple explanation of the curious phenomenon of reversion on crossing, a phenomenon which has puzzled the practical breeder and the man of science. As, however, no fresh principle is involved in such cases there is no need to consider them here in further detail.

Many of the characters of animals with which the breeder deals, owe their manifestation to the presence of one or other definite factor, which is transmitted according to a definite scheme. If these factors are not divisible under normal conditions, they must be handed on through the germ cells as definite entities producing their full effect in each successive generation. Continual crossing of black with red does not diminish the potency of the black factor. So long as it is passed on through a germ cell it produces its full effect. This relative permanence of the factors, assuming it to be well founded, is doubly important

for the animal breeder. It assures him that a character put into a cross can be recovered from it by suitable procedure, even though it may for a time appear to be submerged and lost. It also offers the prospect of understanding, and so of controlling fully the material with which he works; but in order that he may be in a position to do this he must first be provided with an analysis of that material in terms of factors. The factor is for the breeder much what the atom is for the chemist. Though they may have a real existence, in practice both the atom and the factor are used as symbols. The chemist analyses his material in terms of atoms that he has never seen, but the conception of their existence is justified by the control he obtains when using the atomic theory as his guide. The theory guides the analysis that enables him to build up a conception of the chemical constitution of the substance he examines, and this conception enables him to predict the behaviour of the substance in its various reactions. Understanding the atomic nature of the substance, he can thenceforth control it; so also, the biologist is attempting to analyse his material in terms of factors which he has never seen. For if factors are something definite and permanent, following a definite scheme of distribution in heredity, it is clear that the characters of living things can be brought under accurate control by the breeder. They can be dissociated and recombined, just as the chemist dissociates and recombines atoms to make new substances.

This work of analysing the living beast is only beginning. It is only within recent years that the factorial theory of heredity was enunciated, and the scientific man is still busy testing how far it is sound. In simple cases such as those described above, it has certainly borne the test. The skipping of characters for a generation—the persistence of the unwanted recessive even in most highly pedigreed flocks and herds—the unfixable nature of certain types—the explanation of the curious phenomenon of reversion on crossing—the meaning of the break up of the type in the second generation from a cross—the principles governing the recombination of characters—all these things are now straightforward, and will be found treated of in a text book dealing with heredity. But can we interpret in terms of the factorial theory those cases, where at first sight there appears no suggestion of clear cut alternative pairs of characters—where a cross seems to result in a muddled blend—or must we confess that no solution has been found? It is such problems as these that have been engaging our attention at Cambridge for some years past, and a brief account of them will be given in the two following articles.

REPORT OF THE BARBERRY AND THE BLACK RUST OF WHEAT SURVEY IN SOUTH WEST WALES.

W. H. BROADBENT, A.R.C.Sc., D.I.C.

DURING the past two years several cases of the disease known as "black rust" of wheat, caused by the fungus *Puccinia graminis*, have been reported from South West Wales, and in view of the serious nature of this disease the Ministry of Agriculture and Fisheries, in conjunction with the Department of Agriculture of the University College of Wales, Aberystwyth, instituted investigations, the results of which are embodied in this report.

It is well authenticated that the common barberry (*Berberis vulgaris*) serves as spring host for the fungus which causes the black rust disease, and with the object of ascertaining the distribution of the common barberry and the extent of the occurrence of black rust a survey of the counties of Carmarthen, Cardigan and Pembroke was undertaken in the summer of 1920. Owing, however, to the many difficulties involved it has not yet been possible to complete the work.

Methods employed in the Survey:—

Visits to Farms.—As many farms as possible within a selected area were visited. The growing wheat and any straw lying about were carefully examined, and where evidence of disease was found search was made for barberry bushes. This method gave good results but took considerable time.

Interviews.—Few young or middle-aged persons appeared to know anything about the barberry bush, but it seemed to be familiar to the older people, especially women. Good and reliable information was readily furnished by elderly people in remote country districts. The help of schoolmasters in the rural districts was solicited, and in each case valuable assistance and information were obtained.

Exhibitions of Specimens.—Specimens of the common barberry and the black rust of wheat have been exhibited, particularly at the United Counties Agricultural Show, Carmarthen, in July, 1920. By this means interest was aroused amongst farmers which resulted in the location of a number of barberry bushes.

Personal Search.—Personal search, independent of outside help, was also made. The growth, colour and form of the barberry are characteristic, so that while travelling along country

roads it was possible, after a little experience, by glancing round the hedgerows to " spot " bushes growing in the vicinity. This method also yielded good results.

The survey extended over a period of three and a half months (May-August, 1920), but, when the hilly nature of the country and the difficulty of travel are considered, it will be readily understood that in this short period it was not possible to investigate more than one-third of the entire area.

Description of the Bush.—The common barberry (*Berberis vulgaris*), known in Welsh as *pren melyn*, or *pren clefyd melyn*, is said to be a native of Asia. It was introduced into Europe during the fifteenth century and cultivated as a " fruit " bush for several hundred years, until it was found to spread the rust " seeds." The berries were used in the preparation of preserves and jellies, and their juice for making wine and vinegar. When allowed to grow wild it is a tall erect shrub, often as many as 10 or 12 ft. high, and it is a persistent grower. The branches " are arched and hanging at the ends." The bark is greyish in colour and the wood is yellow. The branches bear three-parted spines at the base of the tufts of leaves (Fig. A). The leaves on the young shoots are alternate and green or purple in colour, but on the old shoots they occur in clusters. They are egg-shaped, rather stiff, and have saw-tooth edges (Fig. C). The berries are small, red, oval, and contain one or two seeds (Fig. B). The bark has been largely used for making a concoction which, the old people say, is an infallible cure for yellow jaundice (*clefyd melyn*) and for various diseases of cattle. It is not now, however, included in the British Pharmacopœia and is not used by dispensing chemists as it is not proved of value in these diseases, and its place as a bitter tonic has been taken by a number of drugs, such as gentian, quassia, dandelion or quinine.

Occurrence of Barberry.—Although the survey is incomplete, enough has been done to show that the bush is widely distributed in the three counties. In Carmarthenshire, 100 farms were visited and barberry was found to exist on 60 of them. It occurred chiefly round the homesteads and in the hedges about the farms. In all there were discovered 55 single bushes and 144 yd. of barberry hedge, the latter occurring in strips from 6 to 40 yd. in length. Each strip of barberry hedge, or even a single bush, may be the centre of a local outbreak of the disease, and 64 of these possible centres extending over 24 parishes, were located in this county. In South Cardiganshire, 40 farms were visited and barberry was seen on 30 of them. In all there

were found 25 bushes, and 68 yd. of barberry hedge—30 possible centres of infection, extending over 12 parishes. Pembrokeshire has not been systematically worked, but barberry is known to exist in 14 parishes. At one place there is a stretch of barberry hedge over 100 yd. long, and at another about 70 yd. long. These were the largest stretches met with, and it is a long time since wheat was grown near them. It is clear that if the survey were continued a very great deal more barberry would be discovered.

Extent of Black Rust on Wheat.—Time would not allow of justice being done to this part of the work, and in many places where barberry was found it was impossible to examine the wheat growing in the neighbourhood. However, 45 cases were observed in Carmarthenshire, 15 in South Cardiganshire and 14 in Pembrokeshire. In each of these cases, moreover, barberry was found in the immediate vicinity. From conversations with farmers there can be no doubt that the disease has long been prevalent over the greater part of the three counties.

Results of Personal Interviews.—It has been said that the farmers of a generation ago were aware that the common barberry caused the black rust of wheat. This, however, cannot be said of the present-day farmer in the surveyed district. To him the life-cycle of the fungus is a mystery and the disease is known to most of the farmers under the name of "blast"* and is regarded, as are most other diseases, as entirely due to wet weather. This idea is very deep rooted, and the fact that the life-history of *Puccinia graminis* seemed to many like a fairy tale, made it very difficult to convince them as to the true nature of the disease. Consequently, the way in which the information and advice given was received by the farmers depended chiefly upon the educational attainments of each individual, the quantity and position of the barberry and the condition of the wheat. Very few farmers, who had the black rust affecting their wheat, acted upon the advice given and removed the barberry at once, but every farmer who had barberry on his land admitted that he could never obtain a good crop of wheat when it was grown near the bush. The popular variety of wheat is "Hen Gymro" (Old Welshman) which is particularly susceptible to the black rust.

* Local terminology in respect to plant diseases is very indefinite and confused. "Blast" is applied to all rust diseases of cereals; "blight" and "blast" to the *Phytophthora* disease of potatoes and "blight" to Woolly Aphis on apple trees. The term "duon" (blacks) is also used in South Wales to designate black diseases of cereals such as rust, but more especially smut, while in North Wales bunt and smut are both known as *penddu* (blackhead).

Field Observations on the Disease.—

Spring Stage.—The disease appears on the under surface of the leaves of the common barberry in the form of yellow or orange-coloured swollen patches (Fig. A). These patches vary in size and may be as much as half an inch in diameter, and when examined by the aid of a hand lens are seen to consist of numerous cups known as "cluster cups." During the year 1920 the cluster cups were first observed on the barberry in Pembrokeshire on the 8th May, and from that date they were seen continuously until the end of August. On reaching maturity a few weeks after the appearance of the spot the cluster cups open and the contents (a very fine yellow powder) are easily distributed by the wind. This powder consists of the spores* or "seeds" of the fungus, which when blown on to wheat produce, if conditions are favourable, the summer or "red" rust stage.

Summer Stage.—The summer stage generally appears on the wheat leaves and stems in the form of reddish-brown, elongated spots, which give the wheat a rusty appearance. From its abundance on the stems the disease is termed in America the black *stem*-rust. These spots consist of masses of "summer spores"† which help to spread the disease during summer. The first outbreak of the disease for the year 1920 was noted on the 27th July on autumn sown wheat in Pembrokeshire. The second case was found in Cardiganshire on the 28th July; it was a bad attack, and apparently the disease had commenced much earlier than the date of the visit. This view was confirmed by the farmer, who stated that he had noticed the disease about the first or second week in July. The summer-spore stage was also seen on spring wheat "April Bearded" as late as the 13th September. The time of appearance of the disease in all probability depends on (1) climatic conditions, (2) proximity of barberry, and (3) state of maturity of the wheat.

The Winter or Black Stage.—A winter stage gradually displaces the red summer stage. It appears on the surface of the stem in the form of conspicuous black streaks, which consist of the resting spores‡ of the fungus (Fig. D). During the year 1920 this stage was observed as early as the 27th July, the same date as the red stage, and it was here noted that the transition from the red summer stage to the black stage had taken place comparatively quickly, probably within a fortnight's time. In other

* The spores from the cluster cups or *aecidia* on barberry are called aecidiospores.

† The Summer spores on the wheat are termed uredospores.

‡ The resting spores produced from the black stage on the wheat are termed teleutospores.

THE COMMON BARBERRY (*Berberis vulgaris*).

A.—Flowering Shoot in May or June, showing the Cluster Cup stage of the Rust Fungus forming yellow or orange coloured spots on the leaves. The spines on the stems, usually in threes, distinguish this from most common, garden Barberries.

B.—A Shoot in Autumn, with long red Berries which hang in clusters.

C.—Leaves, enlarged, showing tooth margins and the yellow spots with the Cluster Cup stage of the Fungus. The spores from these cups infect the Wheat.

D.—A small piece of Wheat attacked by Black Rust showing as black lines on the stem.

cases (see below) the change took place more gradually. The black resting spores remain dormant on the straw and stubble through the winter, germinate in the spring and give rise to other minute spores, which infect the barberry leaves, thus completing the life-cycle of the fungus.

A small point, though possibly of great practical importance, was observed in connection with the summer spores. It was noted that in some varieties of wheat these spores (the uredospores) did not break through the epidermis of the stem. The red stage was visible within the stem but it never burst through, merely slowly changing to the black or teleutospore stage. Late in the season, when the transition from one stage to the other was complete, the epidermis was ruptured and the black winter-spores were exposed for dispersal. This might have been an unusual occurrence due to the low temperature prevailing through the summer. However, the matter calls for further investigation, because, if varieties of wheat can be found in which the uredospores are not exposed for dispersal, such varieties will not spread the summer stage. Further, the rupturing of the epidermis injures the wheat owing to the loss of water by evaporation, and if this does not take place in some varieties until late in the season these should give better yields than those in which the epidermis is broken early. In short, varieties of wheat in which the uredospore stage does not break through, the epidermis may be regarded as partial "resisters."

Spread of Disease from Barberry to Wheat.—The spread of the disease from barberry to wheat was observed fairly closely at two places. In one case, there were two barberry bushes in the middle of a hedge alongside the wheat, and in the other there was a strip of barberry hedge, eight yards long, near one corner of the wheat field. In both cases it was obvious that the disease had commenced, and that the intensity was greater, near the barberry. To one of these places two farmers were taken to witness this for themselves, and after going carefully over the field they were fully satisfied that the barberry was a contributing factor in disseminating the disease.

Effect of Black Rust on Wheat Growing in South West Wales.—Although this part of Wales is mountainous and not considered generally suitable for wheat growing, there are districts where wheat might be more successfully grown if it were not for the presence of the barberry and the black rust disease. Most of the farmers endeavour to grow enough for home consumption, and many would sow more wheat if they

could grow a profitable crop. The conditions are clearly least favourable within "Barberry Areas." Some of the farmers have tried wheat-growing so often, with such disappointing results, that they have given up the practice altogether. In face of this evidence, one is forced to the conclusion that the barberry is directly responsible not only for a considerable reduction in yield per acre but also in the amount of wheat grown, and that if this factor were eliminated the yield and acreage would appreciably increase.

It may further be noted that in 1920 the Ministry of Agriculture made a special effort to ascertain all cases of black rust in the country. England as a whole was found to be remarkably free from the disease, and the common barberry is scarce. A few quite small outbreaks were located, the worst case, in Gloucestershire, being in immediate proximity to badly rusted barberry in a hedge. Many farms in parts of Devonshire and Cornwall (which counties have a similar climate to South West Wales) were examined and no case of black rust was observed, and during the inspection hardly a single bush of the common barberry was met with.

Losses caused by Black Rust.—In order to give some idea of the damage caused by this disease, the losses suffered by a farmer in Cardiganshire during the last two years might be quoted. On this particular farm there was, until recently, a strip of barberry hedge ten yards long. In 1919 wheat was grown alongside this hedge and the intensity of the disease was so great that the crop only yielded eight bushels per acre, and the straw was of little value. During 1920 wheat was again grown near the barberry, but on advice the latter was cut down on the 20th May. This date was, unfortunately, rather too late, as cluster cups were present on the barberry and some of the spring spores had already been dispersed. The disease made its appearance in July. Before the crop was cut it was noticed that the intensity of the disease was much less than in 1919, and on being threshed the crop yielded sixteen bushels per acre, and the straw was much better. This decrease in the severity of the attack might have been partly due to the cold, wet summer, but there is reason to believe that the cutting down of the barberry also helped. In any case, the farmer was quite pleased with the result, and will dig up the entire plants with roots before next spring. From this example it will be seen that the losses caused by the disease may be very high, and in years of epidemics the crop

may be practically a total loss. The statistics for the year 1919 give the area under wheat in the counties of Carmarthen, Cardigan and Pembroke as 22,000 acres, and much of this wheat land must fall within the range of influence of the barberry, so that the loss directly attributable to the latter is in the aggregate very considerable, even assuming that the existence of the barberry is not, as many now believe, an absolutely essential condition for the existence of the disease on wheat.

Summary.

1. It is ascertained by means of the survey that the common barberry is widely and plentifully distributed in Carmarthenshire, Pembrokeshire and South Cardiganshire. The cluster-cup stage of the black rust fungus is abundant on the barberry in spring and early summer.

2. On the wheat black rust may be said to be generally distributed over the same area, and causes serious losses every year. In certain seasons the attacks are very severe.

3. Wheat is regarded as a risky crop in these counties, and is certainly not a paying one in barberry areas. As a result there is a reduced acreage under wheat, and this is diminishing.

4. The common barberry is the alternate host of black rust, giving the fungus a good start each spring. In several concrete cases field-observations showed that the disease was most intense near the bushes and had started from them. As long as barberry is allowed to remain it will be a constant source of infection, not only to the adjacent wheat fields, but to other fields on which the summer spores from the wheat will be blown.

5. In more than one case, the removal of barberry bushes resulted in slighter attacks on adjoining fields than in the previous season, but until barberries are eradicated on a wholesale scale no complete elimination of the disease can be expected, owing to spores blowing from other fields. Every bush destroyed means so many less initial infections and the fewer the infections the better will be the wheat crop.

6. Black rust is very scarce in all other parts of the British Isles and there appears no reason to doubt that if the barberry were exterminated in Wales the annual attack of black rust on wheat would subside. This method was adopted in Denmark eighteen years ago, and black rust in that country has now practically ceased to exist.

POLLINATION OF FRUITS.

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IN choosing land for fruit planting, there are several factors to be considered, such as distance from market, climate, aspect, and protection from frost by careful selection of site. The next point is the kind of fruit to be planted, after which comes the choice of varieties suitable for the district. The prospective planter is advised to limit the number of varieties he plants to, say, six varieties of each kind of fruit tree grown, in order to be able to send considerable quantities of each variety to market.

Growers have sometimes planted a single variety alone by the acre (for example, Lane's Prince Albert Apple, Pitmaston Duchess Pear, River's Early Prolific Plum, or Early River's Cherry), with the result that, although it has grown strongly and flowered profusely, it does not fruit satisfactorily. The reason for this is that, in Nature, each apple, pear, plum or cherry tree springs from a separate seed; each tree is a distinct individual. The nurseryman or fruit grower compares the fruit of the different trees and selects those which produce the best fruit. Experience has taught him that the majority of trees grown from seed are not quite like their parents: in most cases their fruits are inferior to those of the parent. He therefore takes shoots of the selected tree and propagates the variety by grafting or budding on suitable stocks. Now each of these trees is part of the original tree: each bears similar fruit and has similar habits.

Nature in general favours cross-pollination for the production of good-sized fruit and seed of vigorous growth, but in the case under consideration each tree is similar, being of the same origin and not grown fresh from seed according to Nature's plan. Pollination by the same variety is, therefore, a form of self-pollination, and does not give the best result in the majority of cases.

Practical botanists in England, America and Australia, who have made experiments on the fruiting of the apple, pear, plum and cherry, find that relatively few varieties are strongly self-fruitful. Of apples, less than one-half of the varieties appear to be self-fruitful; of pears, about one-half; of plums, about

two-thirds; and of cherries, not more than one-third, when grown in the open air; but under the more favourable conditions of glass-house culture a larger proportion of varieties mature fruit with their own pollen.

The best system of planting, as indicated by observation, is to intermix varieties to a certain extent. Thus, for an orchard two or three varieties having somewhat the same blossoming period should be chosen. In other words, the grower should avoid planting varieties that flower very early with those that flower very late. It is also preferable to plant lines of trees with a different variety—*e.g.*, Cox's Orange Pippin and Worcester Pearmain—in alternate rows. In cases where a whole orchard or a large block has been planted with one variety, such as Amber Bigarreau cherry, every fifth tree or so may be regrafted or replanted with another variety, choosing, perhaps, Frogmore Bigarreau, the two varieties being found to cross-pollinate well. In the case of cherries, it is found that not all varieties are inter-fertile, and it may be advisable, therefore, to plant three different varieties in an orchard.

Pollenizing Agents.—Nature's pollenizing agents are chiefly the wind and insects. In the case of *walnuts* and *cob nuts*, the wind carries the light pollen from the catkins to the nut blossoms. In the case of gooseberries and black and red currants, the pollen of which is glutinous, it is necessary for insects to transfer the pollen from flower to flower, for the wind is unable to carry it. In the case of apples, pears, plums and cherries, very little pollination appears to be due to the wind. Hive bees, bumble bees and other wild bees appear to be the insects best adapted for carrying the pollen.

Experiments on the Pollination of Fruits.—From trials in America, Australia, at the Royal Horticultural Society's Gardens at Wisley, and at the John Innes Horticultural Institution at Merton, observations have been made as to the movement of pollen by the wind. The effect of placing muslin around fruit trees in order to exclude insects was also investigated, and it was found that trees so enclosed produced either no fruits or very few fruits, whereas similar trees in the open produced hundreds of fruits; which showed that wind did not help much and that insects were necessary.

In the writer's own trials, *strawberries* under muslin which allowed a certain amount of air movement but excluded insects matured good fruit, the weather being sunny. With strawberries in pots under glass, more perfect and larger fruits

matured on plants that were hand-pollinated, than on the plants, the pollen of which was only transferred by the draft due to the ventilation of the house.

Raspberries and loganberries, enclosed in bags during blossoming but not hand-pollinated, did not mature as well as bushes in the open.

Gooseberries, black, red, and white currants matured hardly any fruit, but where they were hand-pollinated all matured fruit plentifully.

The following table gives a summary of the general results of the writer's trials with fruit tree blossoms made between 1911 and 1920: (1) Excluding insects; (2) Hand pollinating with pollen of its own variety by means of brush or forceps; (3) Hand pollinating with pollen of other varieties.

	Number of varieties experimented with.	1 Insects excluded.			2 Self-Pollinated			3 Cross-Pollinated.		
		No. of bags used.	No. of fruits set.	No. of fruits matured	No. of bags used.	No. of fruits set.	No. of fruits matured	No. of bags used.	No. of fruits set.	No. of fruits matured
Apple	108	540	330	36	252	288	71	323	640	231
Pear	38	115	163	27	73	56	18	97	165	63
Plum	27	71	170	75	51	250	93	98	269	147
Cherry	18	62	53	16	52	141	62	93	323	199
Peach	4	1	1	0	2	2	2	5	8	6
		789	717	154	430	737	246	616	1405	646

On an average five flower buds were enclosed in each bag, but a slightly larger number in the case of cherries. The camel hair brush used for pollinating was sterilised after use by dipping in methylated spirit. There were several handicaps to the experiments, some of which were:— (1) Risk of destruction by insect attack (aphis, psylla, caterpillars hatching out in bag); (2) Risk of destruction by fungus attack (Brown rot disease); and (3) Risk of missing the most favourable time for pollination. Although a larger number of trials in each kind of fruit would have given more accurate information, the results obtained give some data regarding fruit pollination. For instance, in the case of apples, twice as many fruits matured when a variety was pollinated with its own pollen as when left with insects excluded, while three times as many matured with cross-pollination as when flowers were pollinated with their own pollen.

Judging from the opinion of investigators in America, and from the writer's own observations extending over several years

in this country, it would seem that hive bees, bumble bees and the smaller wild bees take the greatest part in cross-pollination. By reason of their habits they are better able to act as carriers of pollen than other insect visitors are, and the operation is further assisted by their hair-covered bodies and legs. Bumble bees work earlier and later as well as in less favourable weather than do hive bees. Again, where there are extensive fruit plantations the number of wild bees is small compared with the number of flowers that should be visited. It is, therefore, of great advantage to keep hive bees near fruit plantations. This is especially the case with cherry orchards, especially in seasons when the weather is unfavourable for the fertilization of the blossoms: the bees are then at hand to cross-pollinate the blossoms during the short intervals suitable for that work. In 1920 the weather was cold, rainy and windy during most of the blossoming time of cherries, yet it is believed that where bees were kept the crop of cherries was much better than where bees were not kept. One orchard was seen which usually produced several tons of cherries, but which in 1920 only produced a peck. No bees were kept in the neighbourhood. Another orchard where bees were kept, produced a good crop.

Hives of bees are probably best placed within a few hundred yards of the fruit plantation. If, as is likely, the fruit grower is too busy to look after the bees himself, it would repay him well to offer a bee keeper free standing room for his hives, or even to pay him a few shillings for each hive placed near the orchard, the bee keeper looking after them and keeping the honey.

In cherries, apparently the only thoroughly self-fruitful variety is the Morello. All other varieties benefit by pollination with pollen of another variety.

Among plums, Pershore Yellow Egg and Pershore Purple Egg and some damsons and bullaces are very self-fertile and can be planted alone. Next, perhaps, come Victoria, Monarch, Czar, Denniston's Superb, but all these crop better when interplanted with other varieties.

In the case of apples and pears, no variety can be recommended to be planted alone in quantity.

Object and Procedure of the Trials.—The object of these experiments was to elicit information on three points:—(1) The effect of excluding insects; (2) Whether the variety matured fruit with its own pollen; and (3) Whether the variety set fruit better with pollen of a different variety.

With regard to the method, paper bags (as used by confectioners for sweets) and muslin bags were employed. The bags were tied over the unopened flower buds shortly before their opening.

About five flower buds each of apple, pear or plum, and ten of cherry were enclosed, and were left untouched until the petals had fallen, when the fruits set were counted and noted.

The bags were removed when the flowers opened, and pollen taken from the same flower (the same tree or another tree of the same variety), was applied with a camel hair brush to the stigmas; in some cases stamens containing pollen were used with forceps for applying the pollen, and after the petals had fallen, the bags were taken off and the number of young fruits counted. When the flowers had opened, the bags were removed, and pollen taken from a different variety was applied to the stigmas, after which the bags were tied up again.

Emasculation is advisable in the case of self-fertile varieties; when buds are emasculated, the stamens of the flowers are removed by scissors, forceps or a fine comb before the pollen has shed; foreign pollen was usually applied at the same time. The bags were afterwards replaced and left on till the petals had fallen, when the young fruits were counted. During the trials, observations were made and notes were taken in each case about once a fortnight until the fruit was mature and nearly ready to pick.

Pear Trials (1911-20).

The results from the following varieties of pears were :—

VARIETIES	LEFT.			OWN POLLEN.			FOREIGN POLLEN		
	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
Conference	25	49	7	13	27	6	13	48	7
Durondeau	13	52	10	4	?		4	?	11
Williams' Bon Chrétien	10	9	1	5	8	0	19	39	15
Dr. Jules Guyot	9	4	0	3	1	1	5	14	9
Beurré Hardy	1	2	1	1	1	1	1	3	3
Doyenné du comice	5	1	1	2	1	1	10	6	1

Other varieties that showed themselves more or less self-fruitful were :—Triompe de Vienne, Petite Marguerite, Colmar d'Eté, Doyenné d'Eté, Marguerite Marillat, Duchesse d'Angoulême, and Pitmaston Duchess.

Pears that failed to mature fruit with their own pollen include:—Beurré Rance, Catillac, Clapp's Favourite, Emile d'Heyst, Fertility, General Todleben, Josephine de Malines, Le Lectier, Marie Louise, Nouvelle Fulvie, Passe Cresanne, and Uvedale's St. Germain. Twelve varieties of pear matured fruit with their own pollen out of 38 varieties tried.

Cherries.

Varieties that proved self-fruitful in these trials:—

CHERRIES more or less SELF-FRUITFUL	LEFT.			OWN POLLEN.			FOREIGN POLLEN.		
	Number of Bags.	Number of Fruits Set.	Number of Fruits matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
Wye Morello : (Perfectly self-fertile)	3	?	10	4	?	17	2	?	2
Morello : (Very self-fertile) ...	5	9	2	10	[illegible]3	26	3	13	10
Roundels	2	10	0	2	17	6	3	14	8
Turk	6	8	1	6	9	6	5	32	18
Circassian	2	0	1	—	—	—	2	12	10
Elton Heart	7	?	2	6	26	4	13	60	42
Napoleon Bigarreau ...	4	13	0	5	25	3	6	37	8

In addition to these, it was found at Merton that Flemish Red and Late Duke were self-fertile, and Mayduke and Archduke partly self-fertile. The following varieties of cherries failed to mature fruit with their own pollen :—

CHERRIES SELF-STERILE (in these trials).	LEFT.			OWN POLLEN.			FOREIGN POLLEN.		
	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
Early Rivers : (9 pollens tried, good fruit matured with pollens of Old Kentish Black, Elton, Waterloo, Amber Bigarreau, Black Eagle, Florence and Turk)	8	2	0	4	5	0	15	89	60
Amber Bigarreau : (8 pollens tried ; fruit matured with Turk, Frogmore, Napoleon and Old Black Heart pollens)	1	0	0	3	0	0	11	24	16
Frogmore Bigarreau : (5 pollens tried ; best results from Amber Bigarreau and Turk)	3	10	0	3	16	0	5	25	18
Black Eagle : (Fruit matured with pollen of Knight's Early Black)...	4	0	0	2	0	0	5	7	4

The following also failed to mature fruit in these trials with their own pollen:—Kentish Preserving, Knight's Early Black, Old Kentish Black, Waterloo; and at Merton:—Black Tartarian, Bigarreau de Schreken, Bigarreau Noir de Guben, Bigarreau Jaboulay, Governor Wood, Guigne d'Annonay, and White Heart.

Trials in the pollination of cherries seem to be of special importance, as so many are self-sterile, and some varieties are inter-sterile, or nearly so. Cherries need patient and numerous trials extending over several seasons, for results of one year do not absolutely tally with those of another year. Season, position of trials on tree, health or constitution of the tree, disease, insects, accidents, frosts—all these influence results and make trials advisable on different trees, in different orchards and in different localities. Although the result of individual trials may vary somewhat with the order of blossoming, yet the general results are the same year by year, showing the advisability of inter-planting varieties for cross-pollination and demonstrating the value of hive and wild bees in carrying pollen from flower to flower.

Apple Trials (1911-1920) : Self-fruitful Varieties.

APPLES more or less SELF-FRUITFUL.	LEFT.			OWN POLLEN.			FOREIGN POLLEN.		
	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
The following are given as examples:—									
Lord Derby: (With own pollen it matured as large fruit as average, some being among largest on tree; matured fruit with pollen of Grenadier, Charles Ross and Bismarck)	7	15	4	17	46	11	8	11	5
Irish Peach: (Fruit from "Left" and "Self-pollinated" as good as average)	19	49	5	17	58	16	3	11	6
Newton Wonder. (Good fruit matured with own pollen; from 9 cross-pollinations fruit only matured with pollen of Lord Derby)	17	4	1	4	8	5	11	38	3
Worcester Pearmain: (7 foreign pollens tried; best results with Cox's Orange, Allington, Beauty of Bath and King of the Pippins)	14	4	0	9	7	2	26	46	23

Space will not permit of further details, but the following additional varieties proved more or less self-fruitful in these

trials:—Potts' Seedling, Summer Golden Pippin, Christmas Pearmain, Baumann's Red Winter Reinette, Crawley Beauty, Miller's Seedling, Brownlee's Russett, John Downie Crab, James Grieve, Ecklinville Seedling, Ellison's Orange, Charles Ross, Golden Spire, Early Red Victoria, Baldwin, Ben's Red, White Transparent, Peasgood's Nonsuch, Adam's Pearmain, Rival, Striped Beaufin, Washington, King of the Pippins, Bismarck, Ribston Pippin, Rambleur Pepelin, Egremont Russet, Warner's King, American Mother. Other varieties found self-fertile elsewhere include Stirling Castle, Keswick Codlin, Devonshire Quarrenden, Cellini, Coronation, and Duchess of Oldenburgh.

The following apples failed to mature fruit in these trials when "left" or when pollinated with their own pollen:—

APPLES that appear to be SELF-STERILE (or very nearly so)	LEFT.			OWN POLLEN.			FOREIGN POLLEN.		
	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
Typical examples:—									
Lane's Prince Albert: (No attempt to set fruit with own pollen; matured fruit with pollen of the Queen and Bramley)	10	0	0	7	0	0	8	8	4
Grenadier	9	1	0	3	0	0	8	16	4
Beauty of Bath ; (4 pollens tried; good fruits matured with pollens of Cox's Orange and Summer Golden Pippin)	8	3	0	2	5	0	5	8	2
Bramley's Seedling	19	2	0	12	0	0	12	15	7
Cox's Orange Pippin: (22 pollens tried: best results from Worcester Pearmain, John Downie Crab, Allington, Bramley, Grenadier, High Canons, Beauty of Bath, Cleopatra, Ribston, and Bismarck; 9 varieties failed, including Lane's Prince Albert)	45	0	0	2	2	0	56	108	36
Allington Pippin: (7 pollens tried; Ribston and Worcester Pearmain produced good fruits and Summer Golden Pippin the finest fruit on the tree)	22	3	0	3	0	0	11	17	7

Other varieties that failed to mature fruit with their own pollen included:—Alfriston, Annie Elizabeth, Barnack Beauty, Beauty of Kent, Belle de Pontoise, Benoni, Blenheim Orange, Brabant Bellefleur, British Columbia, Byford Wonder, Claygate, Pearmain, Cleopatra, Cockle Pippin, Court Pendu-plat, Crimson

Bramley, Cox's Pomona, Duchess Favourite, Duke of York, Foster's Seedling, Gladstone, Hamling's Seedling, Hector Macdonald, High Canons, Hoary Morning, Hormead's Pearmain, Hunt's Early, King's Acre Pippin, Lady Henniker, Mère de Ménage, May Queen, Norfolk Beauty, Rome Beauty, Sandringham, Sanspariel, Seaton House, Striped Beaufin, Sturmer Pippin, The Queen (Saltmarsh's), Wagener, Waltham Abbey, Wealthy, Wellington.

In the trials at Wisley and Merton the following varieties were found somewhat self-fruitful:—Bramley's Seedling, Crimson Bramley, Allington, Sturmer, and Annie Elizabeth; in the case of Cox's Orange Pippin only four fruits matured in 61 trials, which shows that this variety is very rarely self-fertile.

Plum Trials (1911-20).

The following showed themselves self-fruitful:—

SELF-FRUITFUL PLUMS	LEFT.			OWN POLLEN.			FOREIGN POLLEN.		
	Number of Bags	Number of Fruits Set	Number of Fruits Matured	Number of Bags	Number of Fruits Set	Number of Fruits Matured.	Number of Bags.	Number of Fruits Set.	Number of Fruits Matured.
Pershore Yellow Egg (Perfectly self-fertile)	—	—	—	3	36	15	1	13	4
Pershore Purple Egg: (Perfectly self-fertile)	10	47	24	5	36	15	7	26	11
Victoria	8	21	18	3	14	7	8	15	12
Czar	9	46	24	8	42	11	5	37	14
Denniston's Superb	6	19	4	7	37	15	2	9	9
Monarch	3	6	0	3	16	4	3	13	1

Other varieties that showed themselves more or less self-fruitful were:—Damson (? Farleigh), Bradley's King of Damsons, Bullace (yellow with orange streaks), Bittern, Rivers' Early Prolific. At Merton the following additional plums were found self-fertile:—Early Transparent, Early Mirabelle, Golden Transparent, Gisborne (each very self-fertile), Reine Claude Violette, Reine Claude de Bavay, Oullins Golden Gage, Belle de Louvain, Prince Englebert, Giant Prune, Yellow Magnum Bonum, Myrobalan, Red and Belgian Purple; the following were classified as partly self-fertile :—Early Orleans, Early Favourite, and Cox's Emperor. Rivers' Early Prolific, which, with its own pollen, matured only one fruit to about 100 flowers.

The following plums failed to mature fruit with their own pollen:—Admiral, Black Diamond, Coe's Golden Drop, Golden Gage, Jefferson, July Greengage, Old Greengage, Pond's Seedling, and President. At Merton, the additional varieties that showed themselves self-sterile were:—Coe's Violet, Crimson Drop, McLaughlin's Gage. Early Greengage, Reine Claude d'Althann, Wyedale, Frogmore Orleans, Late Orleans, Prune d'Agen, Primate, and Frogmore Damson.

In certain varieties of plum. cherry, and, perhaps apple and pear, it is advisable, in order to obtain the largest quantity of the best fruit, to ascertain whether they cross-pollinate each other well, in addition to planting together varieties that flower at the same time.

In trials with four varieties of outdoor peaches, each appeared to be self-fertile, but fruiting was increased by hand pollinating with a camel-hair brush.

DRY SPRAYING FOR THE DESTRUCTION OF CHARLOCK.

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ONE of the most successful operations now commonly carried out in farming practice is admittedly that of the destruction of Charlock in corn crops by means of a spray, consisting generally in this country of a 4 to 5 per cent. solution of sulphate of copper (Bluestone), that is to say 4 to 5 lb. of sulphate of copper to 10 gal. of water, applied at the rate of 40 to 60 gal. per acre.

In certain parts of the country, however, where the shortage of water is at all times a serious problem for the farmer, wet spraying, if not a matter of impossibility, is at least one which makes too great a demand on the limited water supply, or entails more labour in carting water to outlying parts of the farm than can be conveniently or economically spared. In such districts, a considerable advantage would be gained if it were possible to substitute a dry powder for the wet spray, provided the former was equally efficacious, and not unreasonably expensive.

It was with this object in view that the present experiments with dry sprays of some powdered chemical substances were arranged, and carried out during the last two years.

From published reports it was found that a certain amount of experimental work had already been done on the subject, and a short summary of this is given below.

SUMMARY OF FORMER TRIALS OF DRY POWDER SPRAYS.

The substances tested, of which records have been found, were Calcium Cyanamide (Nitrolim), Sulphate of Iron, Nitrate of Lime, and Kainit.

I. Calcium Cyanamide.*—The experiments recorded in references 1-5 are of German origin, except No. 3 which is Swiss; the quantity of calcium cyanamide applied varied from

*(1) *Jour. Board of Agric.*, Dec., 1907, p. 568.
(2) *Jour. Board of Agric.*, Dec., 1909, p. 761.
(3) *Jour. Board of Agric.*, Jan., 1909, p. 776.
(4) *Jour. Board of Agric.*, Oct., 1913, p. 618.
(5) *Jour. Board of Agric.*, April, 1914, p. 64.
(6) "Charlock Destruction," Bull. I, Agric. Dept., Univ. Coll. of N. Wales, Bangor.
(7) Die Verbreitung u. Bekämpfung der Ackerunkräuter in Deutschland, Bd. 1, May. 1918: *Arbeiten der D.L.G.*, Heft. 294.

60 to 240 lb. per acre, and its destructive effect on the Charlock was said to be generally satisfactory. In Ref. 7, however, a comparatively recent German book which summarises a large number of experiments on weed destruction, the author is much less sanguine as to the value of calcium cyanamide in this direction. In Ref. 6, calcium cyanamide is not recommended.

II. Sulphate of Iron (Ferrous sulphate).*—Ref. 8 refers to work of French origin; the quantity of sulphate of iron used varied from 3 to 4 cwt. per acre, and was stated to give satisfactory results, if applied before the flowering stage of the Charlock. In Ref. 7 given above, the common crystalline form of sulphate of iron is not strongly recommended, but a specially prepared anhydrous form of the salt is said to be efficacious. The latter substance, however, would be difficult to obtain, and would certainly be much dearer than the ordinary crystalline salt.

III. Nitrate of Lime.†—The only reference is to an experiment of German origin, and the results are not very satisfactory.

IV. Kainit.‡—The reference is to an experiment of German origin. The quantity recommended is not less than 1050 to 1250 lb. per acre.

The results appeared to be very satisfactory when moist conditions prevailed at the time of application. Ref. 7, however, states that success is only possible with a powdered kainit, which is a speciality of the German Potash Syndicate.

Note.—No records have been found of any trials made with powdered sulphate of copper.

PRESENT EXPERIMENTS.

Dry Spray Trials, 1919.—These were carried out on Mr. Wilson's farm at Garforth, near Leeds. The substances selected for the test were Nitrolim, Sulphate of Iron, and Sulphate of Copper (Bluestone). Each was obtained in as fine a powder as was possible, and, in the case of the first two substances, the state of fineness was very satisfactory. The copper sulphate was, however, a little coarse, having been partly sifted out and partly ground from the stock supply kept in the laboratory. Unfortunately fresh nitrolim could not be obtained at the

*(8) *Jour. Board of Agric.*, Dec., 1909, p. 761.
(9) *Jour. Board of Agric.*, June, 1911, p. 244.
†(10) *Jour. Board of Agric.*, April, 1911.
‡(11) *Jour. Board of Agric.*, Aug., 1914, p. 451.

time, and that used was several years old. The sulphate of iron, as is inevitable, was oxidised to some extent, but analysis showed it to contain 87 per cent. of the ferrous salt.

The field in which the experiment was conducted carried a crop of barley in which Charlock grew abundantly. The spraying was carried out on June 16th, 1919, and at this time the Charlock was in full flower, and a considerable amount of seed was set. The corn was, on an average, 9 in. high.

Six plots, each having an area of 1/40th acre, were marked out and treated as follows:—

	lb. applied per acre.
1. Nitrolim	140
2. Untreated	—
3. Sulphate of Copper	45
4. " " "	100
5. Sulphate of Iron	200
6. " " "	400

Dry, hot weather prevailed, and, in order to ensure that the powders should adhere to the plants, the spraying operations were carried out at 3 a.m., immediately before sunrise when the dew was on the leaves. The knapsack spraying machine used was Strawson's "Coronette." The day succeeding the spraying was fine, but rain fell 36 hours after the operation, and the weather then remained unsettled for two or three weeks.

Results.—The plots were first examined on June 20th, four days after spraying, and the following notes made:—

Plot 1. No obvious effect.
" 2. Untreated.
" 3. Leaves and flowers of the Charlock badly withered; seed pods still green, but unhealthy in appearance.
" 4. Similar to Plot 3, but effect more marked.
" 5. Leaves of Charlock withered, but flowers and seed pods not greatly affected.
" 6. Similar to Plot 5.

Later examinations showed a quickly developing effect on Plots 3 and 4. On Plots 5 and 6 there was also further deterioration of the Charlock leaves, and the flowers were also affected, but the seed pods were only injured on the plot with the heavier dressing of sulphate of iron.

A final examination was made on July 9th, three weeks after spraying, and the following report made:—

Plot 1. No visible effect.
" 2. Untreated.

Plot 3. On 75 per cent. of the Charlock plants, not only were the leaves and flowers dead, but the seed pods were so shrivelled, that the seed within them had scarcely developed at all.
On the remaining plants only the larger seed pods were living, and these appeared able to set seed. Thistles on the plot were badly damaged, and Coltsfoot slightly damaged.
„ 4. Practically all the Charlock had been destroyed, including even those plants bearing full grown seed pods. Thistles badly damaged; many being killed. Coltsfoot badly damaged, but not killed.
„ 5. The leaves and flowers of the plants were badly withered, but the seed pods were very little injured, and would apparently set seed. Thistles were uninjured, and Coltsfoot very slightly injured.
„ 6. The leaves and flowers of the plants were killed, and in about 30 per cent. of the plants the seed pods were also dead. Thistles and Coltsfoot slightly injured.

No lasting deleterious effect on the barley was observed on any of the plots.

It is evident from the foregoing that the best results were obtained with sulphate of copper, and, in the unbiassed opinion of the farmer on whose field the experiments were conducted, these plots were entirely successful. The sulphate of iron, especially in the heavier dressing, also destroyed the leaves and flowers of the Charlock plants, although its action was obviously slower than that of the sulphate of copper, and would thus be more liable to be checked in the case of rain falling soon after the application of the spray. The total failure of the nitrolim was thought to be due, possibly, to its having been kept for so long beforehand, exposed to the air.

The experiment was regarded as having fully demonstrated the possibility of using dry sprays for the eradication of Charlock, and it seemed probable that, by spraying earlier in the season, equally good results might be obtained with smaller quantities. In the case of sulphate of copper a still greater advantage would certainly be gained if the substance could be obtained in a finer state of division, since obviously the finer the powder the more uniform and economical would its distribution become. It was decided, therefore, to carry out further experiments in the following year, when the defects of the experiments would be remedied as far as possible, and smaller applications of the chemicals would be tested.

Dry Spray Trials, 1920.—These were carried out at two centres, viz.:—

(1) Mr. H. Beachell's farm, near Market Weighton.

(2) Mr. Wilson's farm, Garforth, Leeds.

The same substances were used as in the previous year, with the difference that a new supply of ground nitrolim was obtained, and the sulphate of copper was supplied by a local firm of manufacturing chemists in a much more finely ground state than that used in the 1919 trials. It was decided to test the respective substances in the following quantities:—

Sulphate of Copper	...	...	30 lb. per acre.
" " "	...	...	20 " " "
" " "	...	..	10 " " "
Nitrolim ...	...	...	100 " " "
" ...	...	...	50 " " "
Sulphate of Iron	...	...	100 " " "
" " "	...	...	50 " " "

At the Kipling Cotes centre 10 plots each 1/20th acre were marked out in a field carrying Barley, and an abundant growth of Charlock. When, however, the actual amounts of the spray powders to be used per plot were calculated, they were found to range from 8 oz. to 5 lb., and it was feared that any quantity less than 5 lb. could not be easily distributed over the plots with the knapsack spraying machines at our disposal. It was therefore, decided to make up the bulk in each case to 5 lb. with some inert substance, and Silica was chosen for this purpose. In order to ascertain whether this diluent might in any way, either by absorption or mechanical obstruction of the spray powder. tend to weaken its chemical action, it was decided to put in a control plot to the plot of sulphate of copper at 30 lb. to the acre, in which only 1 lb. instead of 3½ lb. of Silica was added.

The final treatment of the plots was as follows:—

			lb. per acre	*lb per plot.*	*lb. of Silica added per plot.*	*Total wt. (lb.) Spraying Powder.*
Plot	1.	Sulphate of Copper	30	1½	3½	5
"	2.	" " "	20	1	4	5
"	3.	" " "	10	½	4½	5
"	4.	" " " (Control for Silica).	30	1½	1	2½
"	5.	Untreated	—	—	—	—
"	6.	Nitrolim	100	5	0	5
"	7.	"	50	2½	2½	5
"	8.	Untreated	—	—	—	—
"	9.	Sulphate of Iron	100	5	0	5
"	10.	" " "	50	2½	2½	5

Arrangements had been made for spraying the crop much earlier in 1920, when the Charlock was about 3 in. high, but

unfortunately a very unsettled spell of wet weather set in at the time, and the operation was perforce postponed until June 4th. By that time all the plants were practically in flower, but very little seed had been set. The Barley was 6 to 8 in. high.

As in the previous year, the spraying was carried out at dawn in the hope of finding a good dew on the plants; but the weather was very unpropitious—there was no dew, and, to make matters worse, a moderately strong wind was blowing. The leaves, however, were slightly damp from rain, which had fallen during the night, and the experiment could no longer be delayed.

The plots were examined on June 21st, 17 days after treatment. The Charlock was still in full flower, and from a distance two green patches, afterwards discovered to be Plots 1 and 4, stood out clearly in the surrounding blaze of yellow. The following notes were made :—

Plot 1. About 75 per cent. of the Charlock had been destroyed, and the remaining plants were weakly, and much dwarfed.
" 2. The leaves of the plants were badly damaged, and about 50 per cent. of the flower heads destroyed.
" 3. Plants slightly damaged.
" 4. About 85 per cent. of the plants were dead. This was decidedly the best plot of the series.
" 5. Untreated.
" 6. }
" 7. } These plots showed no improvement on the untreated plots.
" 8. Untreated.
" 9. Here the spray had evidently been badly distributed. On that half of the plot at which the spraying was started, the effect was as great as on Plot 4, but, on the other half, not more than 30 to 40 per cent. of the Charlock had been killed. One may assume, therefore, that the first half of the plot had received at least twice as large a dressing of the spray as the second half—say at the rate of 150 lb. to the acre.
" 10. Practically no effect.

As regards the crop, the Barley on the sulphate of copper and the sulphate of iron plots showed marked yellowing four days after the spraying, but, on the final examination on June 21st, it had quite recovered, and showed no signs of damage.

On the whole the results of these trials were better than had been anticipated, but it was felt that their value had been seriously depreciated by the unsuitable weather conditions, which prevailed at the time of spraying. The season was very backward, especially in the West Riding, and as the Charlock there was still in full flower, it was decided to repeat the experiment in a

modified form on the farm at Garforth on which it was carried out in 1919.

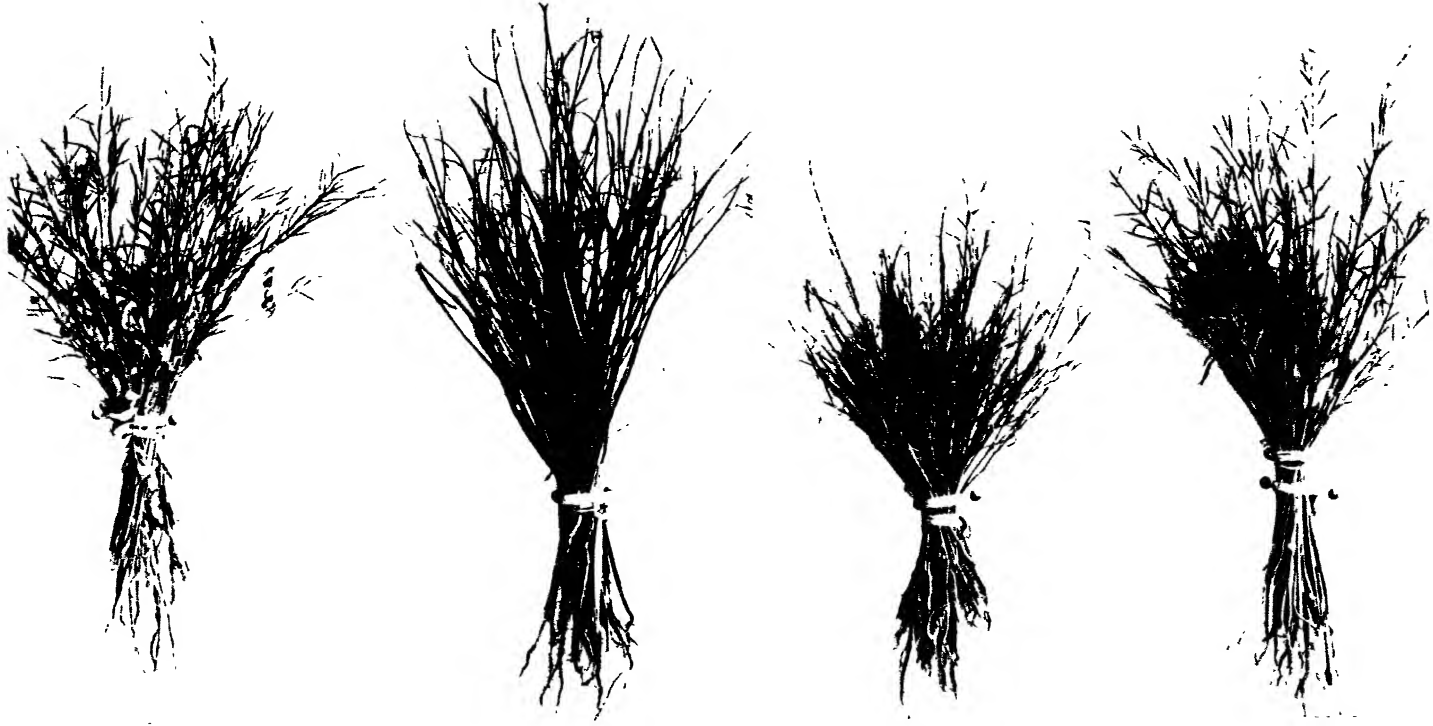
A comparison of Plots 1 and 4 in the Kipling Cotes experiment led us to believe that the presence of a large proportion of Silica in the spraying mixture had exerted some inhibitive effect on the action of copper sulphate. In making up the required quantities of chemicals for the Garforth trials, therefore, a much smaller proportion of Silica was added to make up the bulk, and greater care was taken in the spraying to ensure an even distribution on the plots. It was decided to omit nitrolim from the test, and to include only one plot of sulphate of iron. The latter substance is approximately 2½ times cheaper than sulphate of copper, but this advantage is more than outweighed by the larger quantity which appears to be necessary to give results comparable to those of sulphate of copper.

Five plots, each 1/60th acre, were marked out in a field carrying Rye and Vetches—a thin crop which was spring sown. There was an abundance of Charlock, which, on account of the wet season and the open nature of the crop, had made luxuriant plants bearing a quantity of flowers and seed pods. The following table gives the treatment of the plots together with the actual amounts of the chemicals and Silica applied to each :—

		lb per acre.	*oz per plot.*	*oz. Silica per plot.*	*Total oz Spraying Powder per plot.*
Plot 1.	Sulphate of Copper	40	10⅔	2⅓	13
,, 2.	,, ,, ,,	30	8	5	13
,, 3.	,, ,, ,,	20	5⅓	7⅔	13
,, 4.	,, ,, ,,	10	2⅔	10⅓	13
,, 5.	Sulphate of Iron	50	13⅓	0	13⅓

The field selected for spraying was adjacent to the University farm at Garforth, and it was thus possible to await favourable weather conditions for the operation. This was carried out on June 19th at 3.45 a.m. The weather was very hot, and a thunderstorm occurred at 9 o'clock on the previous evening, after which a heavy mist hung over the ground from midnight onwards. In the morning the air was very calm, and every leaf was drenched with moisture. No rain fell for 48 hours after the spraying, and the weather conditions may be considered to have been ideal.

Results.—After two or three days the plots presented a remarkable appearance, and it was evident that the experiment was a complete success. The previous experiments had shown, however, that the full effect of dry spraying could not be judged



Untreated

Sulphate of Copper.
40 lb per acre

Sulphate of Copper.
20 lb per acre

Sulphate of Iron,
50 lb. per acre.

for ten days or a fortnight after the application, and for that reason only the notes made on the second examination on June 30th are given here. These were as follows:—

Plot 1. Sulphate of Copper—40 lb. per acre
„ 2. „ „ „ —30 „ „ „ } The whole of the Charlock plants had been destroyed. Even the large seed pods were dead and shrivelled, and the plants looked like dead sticks.

„ 3. Sulphate of Copper—20 lb. per acre. All the leaves and flowers were dead, and the great majority of the seed pods were too badly shrivelled to ripen seed.

„ 4. Sulphate of Copper—10 lb. per acre. 75 per cent. of leaves and flowers were dead, and much damage had been done to the seed pods.

„ 5. Sulphate of Iron—50 lb. per acre. 50 per cent. of leaves and flowers were dead, but the seed pods were very little injured.

A week later, bunches of the Charlock plants pulled at random from the respective plots were photographed, and those from Plots 1, 3 and 5 together with a bunch from the untreated part of the field are shown in the illustration. The flowers at this time had disappeared, but seed pods on the specimens gathered from the untreated part of the field and from Plot 5 may be easily seen. As regards the crop, the Rye, although slightly yellowed at first, showed no permanent injury on any of the plots, but the Vetches were rather badly damaged, particularly on Plots 1, 2, and 3.

It should be mentioned that in dry spraying with a Knapsack machine it was found necessary for the operators to wear respirators, since the fine dust of the sulphate of copper spray tended to produce nausea. A simple respirator made of two or three thicknesses of gauze was found to give complete protection. It is very possible, however, that this precaution would be unnecessary in the case of a horse-drawn machine, where the operator is seated at some distance from the spraying nozzles.

Conclusions.—(1) The success in dry spraying for Charlock lies in the choice of a suitable day for the operation. The weather should be fairly settled, and there should be a heavy dew and no wind at the time of application. Provided these conditions prevail, we may say confidently that dry spraying is quite as effective as wet spraying.

(2) Of the substances tested, nitrolim was found to be of no value, sulphate of iron was effective only in quantities, which, on the ground of cost, make it impracticable, but sulphate of copper gave excellent results.

(3) The Garforth experiment of 1920 shows that when the sulphate of copper is finely ground, an application of 20 lb. to the acre is sufficient to destroy the Charlock plants, provided seed has not set. In the majority of reports of experiments on Charlock spraying, emphasis is laid on the necessity of spraying the plants when in the third or fourth leaf, but, from our experience, we are inclined to think that the best results are likely to be obtained if the spraying is carried out just as the plants are bursting into flower. The flower-heads are very easily killed, and the leaf surface exposed to the action of the spray is at this time greater than in the case of younger plants. The effectiveness of the spray is thus increased, and the plants are less likely to recover.

(4) There appear to be a number of Dry Spray machines on the market. We have not tested any of these personally, but some of them should be easily adaptable to the spraying of Charlock. Two of those which have been brought to our notice are said to distribute quantities as small as or smaller than 20 lb. to the acre, and this being the case, the necessity of adding any diluent to the sulphate of copper, as was done in the Knapsack machine, would no longer arise.

(5) A comparison of the relative cost of Wet and Dry Spraying shows that, in this respect also, the latter process compares very favourably with the former. In wet spraying, the formula recommended by recent trials is 16 to 20 lb. of copper sulphate in 40 gall. of water, this making a solution sufficient to spray an acre. In dry spraying, we have suggested 20 lb. of copper sulphate to the acre; in this case, however, there will be a slight additional charge for grinding the material, but this is not likely to exceed 5s. a cwt. On the other hand, the labour entailed and the time expended in the newer process is very considerably less than that required in the older.

We consider, therefore, that provided an efficient machine is used for the purpose, the destruction of the Charlock pest by dry spraying should recommend itself to many farmers, and in particular to those who live in the more waterless districts of the country, where the older method has always been so heavily handicapped.

We wish to express our thanks to Mr. H. Beachell and Mr. Wilson for their kind co-operation in carrying out the trials on their farms, and also to Mr. J. Manby, of the University of Leeds, for the photographs.

"RURAL BIAS" IN SECONDARY SCHOOLS:

THE WORK AT SEXEY'S FOUNDATION SCHOOL IN SOMERSET.

S. L. Bensusan.

At first sight there is little remarkable about Sexey's Foundation School. The buildings that compose it are perhaps more than ordinarily attractive and certainly the situation is quite out of the common. Sexey's stands rather high on land overlooked from a distance by the Quantocks, the Mendips and the famous Dunkery Beacon. From the upper rooms of the School House one can glimpse the Islands of the Severn Sea. The school itself is remote from all great centres of life and action, though within touch of places boasting the most interesting associations. Cheddar is some five miles away, Glastonbury ten, Wells about as far, and the first thought that strikes the casual visitor is that those who teach and those who are taught must admit that their lines are cast in pleasant places. But Sexey's could hardly claim the attention of agriculturists if it were merely an attractive and well-placed secondary school; the special interest lies in the fact that it is one of the few centres in England in which secondary education is associated with what is known as a "rural bias."

There are many agriculturists in this country who feel very strongly that the development of husbandry would be furthered considerably if secondary education took more note of our greatest national industry. They would like to see children who have a natural aptitude for land-work encouraged to develop rather than forced to suppress it, and they believe that there is no more important problem before statesmen to-day than the repopulation of rural areas, with the great resultant stimulus to the production of home-grown food. They feel that, while in the old days the training that the boy or girl of farmer or farm labourer received was adequate to the demands that the future would make, the conditions have been altered entirely by the development of scientific investigation, by the advent of machinery, by the acquisition of precise knowledge and above all by the pressure of the economic situation. The State has recognised that pressure; it is spending considerable sums of money in the quickening of sound production, and consequently it is of first importance

that there should be an ever-lengthening procession through our secondary schools of boys and girls bent upon acquiring the special knowledge that will enable them to take advantage of modern conditions. The Board of Education is not unmindful of the new needs that the past few years have brought into being, and while expert opinion there is convinced that, if it is to be effective, secondary education must be an all round education and not limited in scope or purpose, yet certain concessions have been found possible. Provided that the curriculum of a secondary school embraces a modern language, some science and English, the " rural bias " is recognised and even encouraged. The new development is at present only in its first stage, and Sexey's is one of four secondary schools in which the " rural bias " may be seen in the working. Welshpool County School for Boys is another, Knaresborough Rural Secondary School in the West Riding is a third, and the Dauntsey Agricultural School at West Lavington in Wilts the fourth. In three years at Knaresborough thirty per cent. of the boys went on to farms, while others took to surveying or garden work or emigrated to the Dominions. At Welshpool out of 250 boys more than thirty per cent. went on to farm work or took up estate office work and surveying. At Sexey's where the majority of the pupils are associated directly or indirectly with agriculture the proportion that seeks a living from it is larger still.

Sexey's differs from Knaresborough and Welshpool in so far as it is a co-educational school, the boys and girls working in the same classrooms to a like end. While it is a secondary school by virtue of its four-year course for children who may come in at the age of twelve, there is a preparatory side for boys and girls, so that it is possible for a child whose training and associations suggest the possible development of an agricultural bias to start at Sexey's and receive complete education there.

The support received for this farm, which is of course a branch of the school and was a subsequent addition to it, comes from many sources. The original foundation was the Manor of Blackford, left by Hugh Sexey, Auditor to Queen Elizabeth and James I, for educational and other purposes in the year 1617. Out of funds provided by this foundation a school was built, and when the Rev. Edward Smith, who had been Instructor in Agriculture under the Wiltshire County Council, was asked to take charge of it, his keen interest in farming

FIG. 1.—The old building as it was. Note the windows boarded up (See Fig. 2)

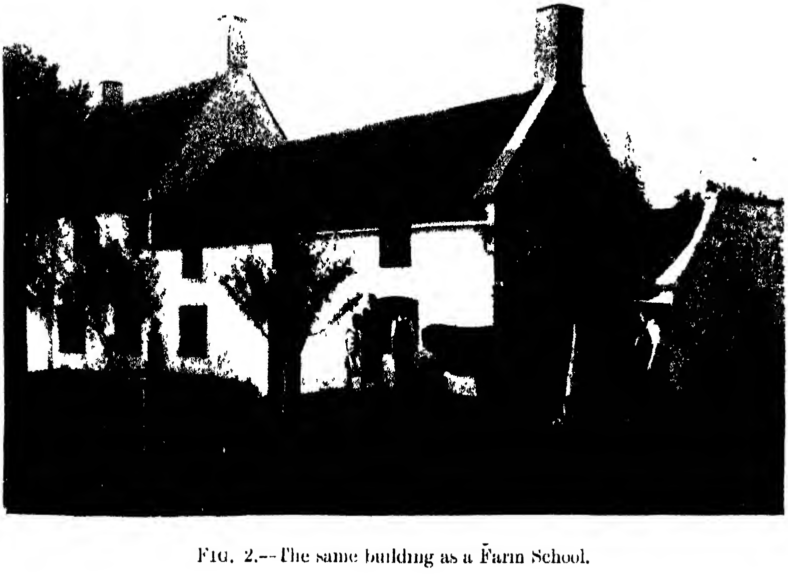


FIG. 2.—The same building as a Farm School.

led him to consider the question of establishing a training farm within easy reach. A stone's throw of the school there was a small holding of some twenty acres or so, derelict for many years, the rich land gone to waste, the little farmhouse boarded up (Fig. 1). It should be remembered that this was more than twenty years ago when agriculture was at a very low ebb and even those who farmed the rich Somersetshire land were hard pressed to make a living. Mr. Smith was of opinion that the possibilities of improvisation, if grasped by boys and girls who have a natural instinct for land work, would provide them with a key that would open many a door through which, in normal times, only those could hope to pass who are plentifully supplied with the world's goods. He acquired the derelict holding, and being a skilled practical man with quick eye and trained hand, he managed to convert the farmhouse into a farm school (Fig. 2) at the trifling expense of £150. Those who have any working acquaintance with the present cost of adaptation will be astonished to realise how much could be done with a very little so recently as twenty years ago. The ground floor of the farm has been divided up into a dairy, a cheese-making room, a cheese-store for ripening and an incubator house. Beyond these there is a workshop, a milking byre, a pigs' kitchen and a cider house. On the upper floor there is a delightful little classroom with well-equipped agricultural library, and there are other rooms for the study of methods of fruit storage and for demonstrations in seed ripening and apiary work. Beyond the farm there is one outhouse that has been supplied with power for the economic handling of every farm product and its adequate preparation as food for stock. The mixing floor is concreted and the motor is driven by electricity supplied from Wedmore a mile or so away. There is a cow house and an up-to-date poultry station, and there are piggeries.

A special and notable feature of this small farm is that the actual work is not done by the pupils. Mr. Smith holds very strong views on this matter, and is of opinion that it is not right to ask any of his boys or girls to do work that should command payment. Yet although the total grant in aid of the farm school is limited to about £200 a year—a Grant from the Board of Education, the regular Grant to Secondary Schools, and school fees—the farm maintains three men at the standard wage and supplies the school, with its 150 pupils and resident staff of nearly a dozen people, with all the fruit, vegetables, eggs, milk, butter and bacon consumed.

The great difficulty that the school has had to face on its farm side is the postponement of the operation of those provisions of the Act of 1918 by which parents were compelled to keep their children at school until the age of 16. The training at Sexey's being thoroughly practical and modern, attempts have been made by parents who are working farmers to withdraw their boys and girls before they have completed their course, because they find that after a couple of years or less in the farm school they can replace a skilled man.

Mr. Smith finds as a result of his long experience that in addition to giving the main school " rural bias " the foundation of the farm school serves to provide fitting occupation for those boys and girls on whom a purely academic training would be wasted, while affording opportunities to those who show a special aptitude and wish to travel beyond the boundaries of ordinary farm work to prepare for an agricultural college. Pupils come from all parts—from local elementary and private schools, from secondary schools, and in some cases from the Continent. Perhaps because Mr. Smith is a very keen botanist, botany is the foundation of much of the outdoor practical work of the farm school. In fact every pupil has two years of botanical work, theoretical and practical, before the farm school can be reached.

Naturally all demonstrations are carried out on a small scale, but it is abundantly clear that effectiveness is not a matter of acreage. There is a quarter of an acre of garden land kept under every variety of seasonal crop, so that the sequence of the market-gardener's work can be followed. There are greenhouses; there are cool and heated frames. In addition to delightful orchards there is half an acre of fruit garden in which fruit culture is taught in all its branches—grafting, budding, transplanting and the rest—while owing to the rich soil and the mild climate, transplanting work is carried on under conditions that must excite envy among those who have learned their orcharding on colder and less grateful lands.

The farm work itself embraces nearly all the problems that agriculturists must consider. For example, to take mangold cultivation, there is a plot some 110 yd. long and 11 yd. wide divided into three strips. One is manured with superphosphate at the rate of 4 cwt. per acre, sulphate of potash ½ cwt., nitrate of soda 1 cwt., salt 3 cwt. On the next plot the rates are superphosphate 6 cwt., sulphate of potash ¾ cwt., nitrate of soda 1½ cwt. On the third the rates are: superphosphate 8 cwt., sul-

phate of potash $1\frac{1}{4}$ cwt., nitrate of soda 2 cwt., salt 3 cwt., and beyond those three plots there is a little triangular piece on which mangolds are being grown without manure. A quarter-acre plot of grass land has been divided up, all having been dressed with potassic superphosphate at the rate of 6 cwt. per acre, while half has received in addition nitrate of soda at the rate of 1 cwt. per acre. The manurial value of each is carefully explained and the pupils can compare for themselves the actual results obtained. Elsewhere swedes are being grown on plots with farmyard manure applied at the rate of 25 tons per acre over the whole, while one half has an addition of superphosphate, potash and sulphate of ammonia, and the other has superphosphate, potash and nitrate of soda instead. Potatoes are grown under a variety of conditions. One plot has farmyard manure at the rate of 15 tons to the acre and is then divided up, one half receiving an addition of superphosphate, potash and sulphate of ammonia, the other superphosphate, potash and nitrate of soda, this additional manuring being the same as is given to the swedes. In addition to this there is another potato plot divided into five parts. The first has no manure at all; the second has superphosphate; the third superphosphate and potash; the fourth superphosphate, potash and nitrate of soda; the fifth superphosphate and nitrate of soda but no potash. Here too the pupils will be able to see for themselves the effect upon the yield of crop. The use of machinery and its value on the farm have not been forgotten and the necessary attention is given to farm book-keeping, farm correspondence and costs.

The ordinary course in agricultural science is open to boys and girls of the school between the ages of 15 and 17 who have reached the fifth form or can give evidence of having received public secondary school education up to the fifth form of the school from which they have come. In addition to farm book-keeping based on the year's accounts of the school farm, the course of study includes land measurement and surveying, the theory and practice of dairying—including laboratory practice, the use of the Gerber tester, the clean production of milk, the making of butter and cheese, the feeding and care of live stock, including the preparation of rations on a scientific basis, and the principles of land cultivation and manuring on grass land, arable and moor.

The Somersetshire orchards are unfortunately more remarkable for their beauty than for the state of their preservation, and a spirited effort is being made at Sexey's to teach students the

value of pruning, spraying and a general clean up of dirty trees. In order to make the lesson memorable, some trees are cared for and others are left alone, so that the comparison is clear and obvious. Cider making is also undertaken by pupils, and in the laboratory they carry out qualitative analyses of feeding stuffs, manures and milk. The principles of drainage and elementary physiology are included in the curriculum, and practical demonstrations in bee-keeping are part of the summer term's work. The course for girls includes all branches of dairy work, book-keeping, correspondence, poultry-keeping, and a study of foods and feeding, together with practical gardening, fruit culture, fruit storage and preservation. Pupils hav taken County Agricultural Scholarships, both senior and junior, and some have found high places in Agricultural Colleges and elsewhere. The practical work is associated with frequent lectures so that those who learn may understand the principles underlying their teaching.

By reason of the Government grant for secondary schools and with the aid of the County Authorities, the Board of Education and Sexey's Foundation, it is found possible even in these days of high prices to charge the parents of boarders no more than £42 a year for board, lodging and books. Moreover—and this perhaps is one of the most important aspects of the whole undertaking—the terms under which the school is conducted provide that 25 per cent. of the admissions in any year must be free of charge, and this has a particular significance in view of the "rural bias" because it means that for every hundred pupils who can pay there must be the fixed proportion of those who are unable to do so. Here is the chance for the child of the agricultural labourer. It is not sufficient to give the agricultural labourer the minimum wage, because it leaves him without prospects and he sees no better future for his children than that of the so-called "unskilled worker." He wants something better, and here in the remote Somersetshire Country he finds what he needs. At the present time 40 per cent. of the children at Sexey's are not paying pupils.

It is interesting to note that Sexey's School started in a barn and was not housed in its present attractive quarters until the success of the undertaking had been proved beyond all question. The Farm School was added to the premises as a going concern about the year 1913, when Mr. Smith handed over the buildings to the School Authorities. To-day the full limit of the accommodation has been reached, and so great is the school's popularity

that vehicles ply daily between Cheddar and Blackford to take pupils to and from the railway station.

It does not require any special gift of vision to see in the secondary schools with a "rural bias," of which Sexey's is so pleasing an example, a prospect that may go far to change the outlook of those who work on the land. It is admitted on all sides that no class of our population has done better work for the country or has received less return for it in years past than the agricultural labourer. The War brought these truths home to the community at large, and the worst of the farm labourer's disabilities have been removed by the Agricultural Wages Board and the Agriculture Act, while Village Clubs and Women's Institutes have developed the social side of rural life with the very happiest results. But this is not enough. The agricultural labourer's children have a right to be prepared to help the community at large by the development of their natural aptitudes along the most familiar lines. Welshpool, Dauntsey's, Knaresborough and Sexey's may constitute a small beginning, but as the knowledge of these undertakings grows and the value is recognised by the community it is not too much to hope that we shall see the "rural bias" a feature of secondary schools in all suitable districts, and that year by year they will send out a steadily increasing number of skilled workers on to the land. The expense is trifling; the reward is great; and in giving every encouragement to such a movement as this, the State will be recognising in very practical fashion its debt to those who have raised a considerable part of the nation's food in most disheartening conditions for many years. The rising generation should prove capable, in the new circumstances that will follow, of increasing the output to a point at which we shall stand far nearer self-support, and the security that attends it, than we are to-day.

HOP-"MOULD" AND ITS CONTROL, I.

E. S. SALMON,

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Introductory.—The disease known variously as " mould," " red mould " or mildew is the cause in many seasons (*e.g.*, in 1920) of serious financial loss to the hop-grower. The other serious disease of the cultivated hop is the " fly " or hop-*Aphis*. The modern hop-grower has fully acquainted himself with the life-history of the *Aphis* and when it arrives he " washes " the hop garden with such energy and technical skill that even the most persistent attacks are kept under.

The cause of hop-" mould " has only comparatively recently been understood by the hop-grower. The farmer who still believes that " mould " is due to certain atmospheric causes or to the unhealthy condition of the sap of the hop-plant caused by errors of cultivation or manuring is now rarely met. Most farmers now not only recognise that " mould " is of fungous origin, but know the main points in the life-history of the particular fungus concerned. Prof. J. Percival and Mr. A. Howard, working at Wye College, largely helped in the spread of this knowledge. The late Mr. W. H. Hammond, a hop-grower as well as scientist, was the first to point out* that " red mould " and " mould " were two forms of the one disease.

The fact that at the present day " mould " takes far too heavy a toll of the crop in many quarters is due chiefly to the following causes :—(1) Although the use of sulphur (an efficient remedy against " mould ") is general, the farmer does not, as a rule, use it early enough in the season. (2) The thorough control of " mould " is dependent upon the taking of many *indirect* measures, some of them cultural. (3) Too often the hop-grower depends upon some utterly fallacious measure for controlling the disease.

It is the object of this article to treat the subject of " mould " fully from these three standpoints.

Life-history of the Hop-" mould " or Mildew.—A photograph of a hop-leaf with several spots of " mould " is given in *Fig. 1.* The general appearance, under a strong magnifying glass or microscope, of a spot of hop-" mould " is shown in *Fig. 2.* The " spawn " (*mycelium*) of the fungus (*Sphærotheca*

* *Journn. S.E. Agric. Coll.*, IX, p. 19 (1900).

Humuli (D.C.) Burr.)—composed of a mass of interlaced fine white branched threads (*hyphæ*)—creeps over the surface and at short intervals sends minute branches—the " suckers " (*haustoria*)—from the under surface of the threads into the cells of the hop-leaf or " hop." These suckers extract from the sap of the hop-plant the food the fungus requires—much as the needle-like proboscis of the hop-*Aphis* does when this insect is feeding. From the spawn upright branches (*conidiophores*) arise, each bearing a necklace-like chain of summer-spores (*conidia*)* (*Fig. 2*).

As each summer-spore (*conidium*) at the top of the chain becomes ripe, it separates and becomes free (*Fig. 3*), fresh spores being formed below as the top ones become ripe and fall off. In this way myriads of spores are produced in favourable weather conditions and accumulate in white, " powdery " masses over the surface of each spot of " mould "—a condition indicating infallibly that " mould " is " on the run." These summer-spores serve for the rapid propagation of the fungus, and being exceedingly minute and light they are easily carried by the wind for distances of a mile or more. This manner of distribution accounts for the fact sometimes to be noticed that an epidemic of " mould " appears suddenly in a hop-garden hitherto entirely free. If our eyes were able to observe such small objects—or if the summer-spores were much larger—we should frequently see in the air during summer in hop-growing districts a white dust-like cloud composed of myriads of these spores—much as we often see masses of "thistle-down" blowing about. Prof. F. M. Blodgett has computed that on a square inch of leaf-surface covered with hop-mildew 2,800,000 summer-spores are produced, and remarks† " from this it will be seen that, while the large majority of these spores may perish, there may still be enough left on a single leaf to infect a whole hop-garden."

Each summer-spore behaves like a seed in giving rise to a new individual. On reaching a healthy leaf or " hop," it at once proceeds to infect it; it puts out a root-like germ-tube, with a terminal knob (*appressorium*) which attaches itself firmly to the surface of the hop-plant (*Fig. 4*). Within 24 hours a sucker is produced from the under surface of the knob. The sporeling, or young fungus, is now both firmly anchored and supplied with food; it rapidly develops the threads of the spawn and, under favourable conditions, a " powdery " patch of " mould " with chains of summer-spores is produced within a week or ten days.

* These can easily be seen with a pocket magnifying glass.

† Cornell University, Agric. Exper. Stat., Bull. 328 (1913).

As each of the two million odd spores produced in a large patch of " mould " is able to propagate in this way, it is no wonder that the hop-grower, unless the earliest patches are dealt with, is often faced with sudden outbreaks of " mould " on an epidemic scale. The explanation of the efficacy of early sulphuring lies in the fact that the first powdery patches of mould formed in the season are killed before they have time to start hundreds of fresh infections in the neighbourhood.

So long as the hop-plant continues to produce fresh sappy growth, such as young leaves, lateral shoots, " runners," and the " burr " stage or young hop-cones, the mildew continues to produce its summer-spores. These spores, however, are quite unable to survive the winter months, when the hop-plant dies to the ground. It is important for the farmer to understand in what form and also where the "mould " survives from year to year, since ignorance on these points leads in many cases to the adoption of useless and expensive measures.

The stage in which the fungus passes the winter is far less noticeable than the white " mould." It can readily be seen with a pocket-lens, however. If during late summer the " mould " on the lower leaves is examined, minute round blackish-brown bodies (conceptacles) will be observed, usually densely clustered on the " spawn " (*Fig. 5*). Each conceptacle (*perithecium*) contains within it a transparent sac (*ascus*) holding 8 winter-spores (*ascospores*). These conceptacles are also found plentifully on " mouldy " hops. If a hop with " mould " or " red mould " is picked to pieces, hundreds of these dark, round bodies can be seen (with a pocket-lens) on the surface of the " petals " (bracts and bracteoles) (*Fig. 6*).

When the leaves decay, or when " mouldy " hops are left unpicked and allowed to blow away, the conceptacles with their winter-spores reach the soil of the hop-garden and remain there in security through the winter-months. The following spring—usually in May—these winter-spores are liberated in the following manner. Each conceptacle—when the weather conditions are right—absorbs water, swells and cracks open, exposing to view the inner sac (*Fig. 8*). The sac then likewise absorbs water and swells up, expanding like the envelope of a balloon (*Fig. 8*), until the tension on the expanding wall is so great that the sac bursts and the winter-spores are expelled forcibly through a slit into the air (*Fig. 8*). When thus liberated the winter-spores are wafted about by air-currents and some get carried to a hop-leaf—usually the lower leaves on the bine. The winter-spore

FIG. 1.—Hop-leaf, showing several spots of "Mould."

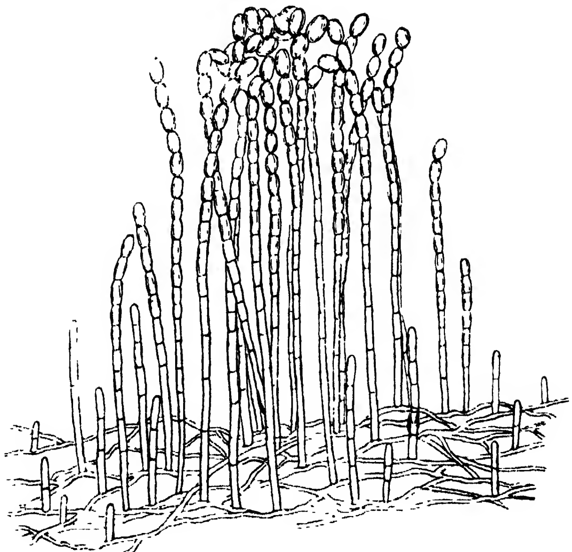

FIG. 2.—Young patch of "Mould," showing the creeping "Spawn" producing upright branches with chains of "summer-spores." Much enlarged.

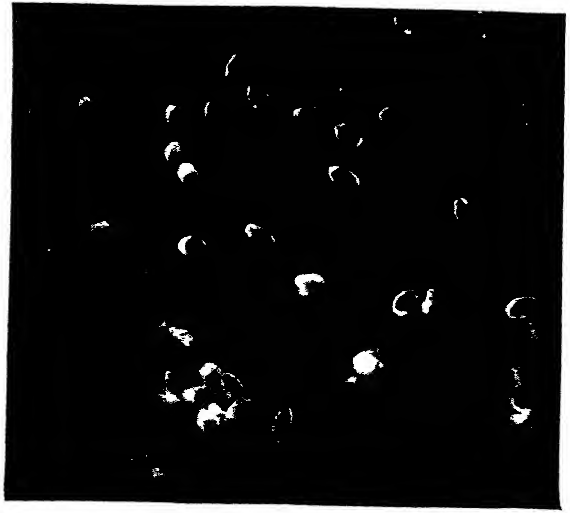

FIG. 3.—Photograph through the microscope of ripe, detached "summer-spores." Highly magnified.

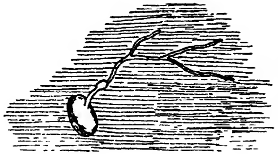

FIG. 4.—Drawing of a single summer-spore germinating on the surface of a hop-leaf. The "spawn" is just beginning to be formed: in 7-10 days it will present the appearance of a small patch of white "Mould," shown in Fig. 2. Much enlarged.

FIG. 5.—Hop-leaf with dark-brown patches of conceptacles (containing "winter-spores") forming on the "Spawn" of "Mould."

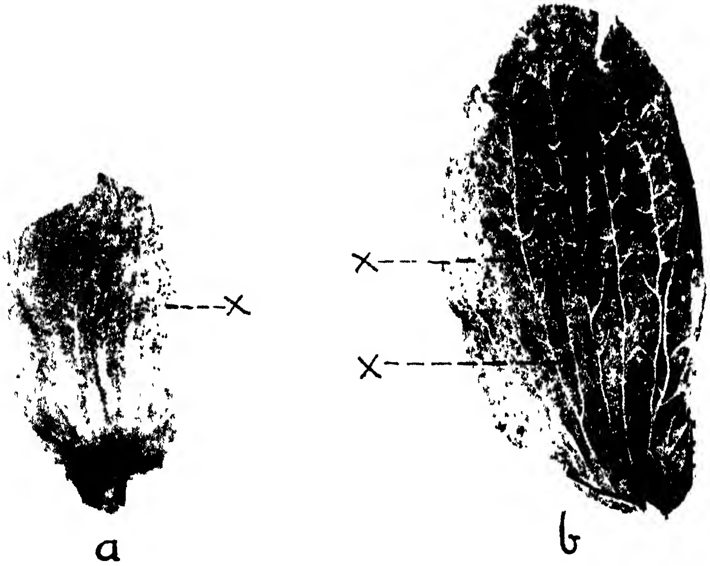

FIG. 6.—Two "Petals" (*a*, a *bract*; *b*, a *bracteole*) of a hop affected with "Red mould." The black specks X are the conceptacles containing the "winter-spores."

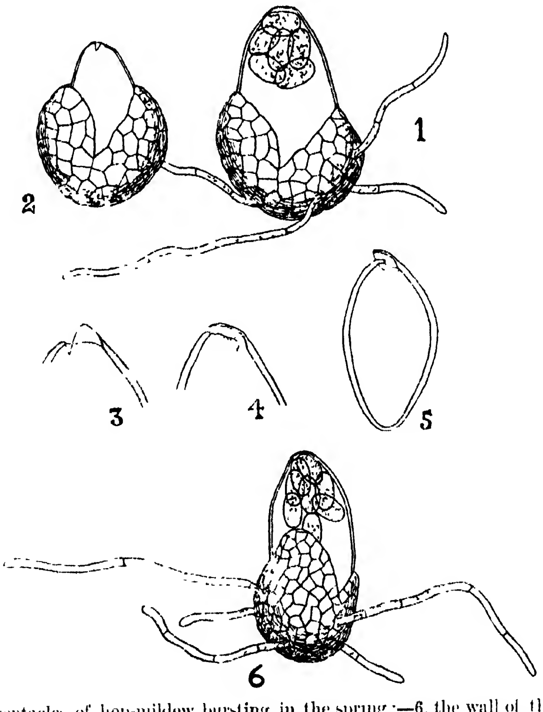

FIG. 7.—Conceptacles of hop-mildew bursting in the spring:—6, the wall of the conceptacle has just burst, and the inner sac has begun to swell up; 1, the sac has swollen up to its full extent, it then suddenly explodes, forcibly expelling the "winter-spores" through a slit (3, 4, 5) into the air: the empty sac then shrinks back (2).

FIG. 8.—A hop in "Burr" attacked by "Mould."

a *b*

FIG. 9.—Drawings showing sulphur killing "Mould." *a*, a particle of "flowers of sulphur" destroying three chains of "summer-spores," after three days. *b*, two branches bearing chains of spores; the one to which the particle of sulphur was applied showed, after three days, the terminal seven spores shrivelled up and dead, while the adjacent branch, approximately only $\frac{1}{500}$ inch away, remained unaffected. Highly magnified.

then germinates at once, infecting the leaf in exactly the same manner as the summer-spore does (*Fig. 4*), and in a few days a " powdery " patch of white " mould " is produced, bearing hundreds of summer-spores. Thus is brought about the *first or primary outbreak of " mould " for the season.*

As the result of infection by a single winter-spore there may arise, within three weeks, many hundreds of little patches of " mould " scattered through the hop-garden, unless by the use of sulphur during May and June the primary outbreak is smothered and killed before its summer-spores have time to spread. The hop-grower must realise that when in May and June he sees the " fly " arriving on his hops, at the same period the winter-spores of the mildew (unfortunately invisible) are being shot out of the soil and the first infections are occurring.

From the point of view of the practical farmer, the most important facts in the life-history of the hop mildew are (1) the fungus is confined to the surface of the above-ground parts of the hop-plant, never entering the " hill " or occurring on the roots; (2) during the winter months it exists only in the form of winter-spores within closed conceptacles which become dispersed over the surface of the soil of the hop-garden. The following year, about May, the winter-spores are liberated and produce at once the highly infectious white " mould." There is no living spawn existing through the winter.

Damage caused by " Mould ":—

(*a*) *To the Leaf.*—Although serious injury to the hop-leaf is seldom caused by "mould," it is essential that it is destroyed on the leaves, as otherwise the summer-spores produced there in immense numbers spread the disease to the "burr" and hop-cones where irreparable damage may be done. Further, it is comparatively easy to kill the mildew on the leaves, since the mildew is fully exposed and hop-leaves are easily sulphured, whereas " mould " on the hop-cones is difficult to deal with.

(*b*) *To the "Burr."*—The greatest damage is caused when " mould " attacks the "burr," *i.e.*, the female inflorescence which develops later into the hop. Each inflorescence when ready for fertilisation by pollen from a male hop shows a bunch of spreading branches (*stigmas*)—a stage called the "brush" by farmers. If summer-spores are carried by the air to the "brush," they readily infect it, it becomes white with "mould," and is soon converted into a hard white knob. with the result that no hop is formed. (*Fig. 8.*) The infection of the "burr" is usually brought about by summer-spores set free from powdery patches of "mould" on the hop-leaves in the same garden ; more rarely the spores are carried on the air from a neighbouring hop-garden infested with "mould." If the "burr" becomes attacked by "mould", it is impossible to save it.

Everything possible should be done, therefore, to help the hop plant to pass through as quickly as possible the critical stage when it is in "burr." If no pollen-dust from a male hop reaches the "brush," the hop remains in burr some 10 days longer than when pollen has been supplied, and then sets into a seedless hop, whereas if pollen reaches the brush, the "burr" stage passes quickly, and a large seeded hop is produced. It is consequently a wise precaution—as Mr. A. Howard first pointed out*—to plant a certain number of male hills in the hop-garden, more especially as it has now been conclusively proved that fertilisation of the "burr" is essential for the production of well-grown-out hops.†

(c) *To the Hop.*—Serious injury is very commonly inflicted by "mould" on the hop-cone in all stages of its development. All kinds of malformations of the cone may be met with; a very young hop may be entirely converted into a white "mouldy" knob, or the young cone may be "eaten into" on one side, or at the base or at the tip; or hops may occur which are normal in shape and size and yet diseased to the extent that many of its "petals" bear the conceptacles of the mildew. It is among the ripening hops that the condition so well known as "red mould" is met with. "Red mould" was long thought to be due either to the effect of certain atmospheric conditions (hot sun, mist, &c.), or to the attacks of some special parasite on the hop-cones, but it is now definitely established that "red mould" is nothing more nor less than white "mould," and the one can change into the other according to the part of the hop plant that is attacked. The name "red mould" is given to it on the ripening hop-cones, because under the attacks of the mildew the "petals" turn a foxy- or reddish-brown colour; very little "spawn" and few summer-spores are formed, hence the mildew does not become white nor resemble the "mould" elsewhere, but conceptacles with winter-spores are produced abundantly. It is one of the most insidious forms of the disease, and can only be dealt with by the rigorous suppression earlier in the season of all outbreaks of white "mould."‡

Preventive Measures.—*Direct.*—"Flowers of sulphur" (pure, sublimed sulphur) is the great specific against "mould," as all hop growers know. It should be applied much earlier in the season than is generally done. Owing to the fact that winter-spores arise from the soil during May, the first outbreaks of white "mould" for the season usually take place (unknown to the farmer) during that month. A good knapsack sulphurator should be employed to apply the sulphur to the leaves of the bines; the under surfaces of the leaves (which are usually infected first) should be well dusted over and a

* *Journ. S.E. Agric. Coll.*, XIV. p. 211 (1905).

† *Journ. Board of Agric.*, XX, 953 (1914).

‡ Last season (1920) reports were received of the prevalence of "red mould" in the hops of only those hills in the proximity of male hops ("seeders"). It seems probable, however, that in these cases there was no mould at all, but that the "going off" in colour (that was mistaken for "red mould") was due to the presence of partially over-ripe cones. Hops will not uncommonly show some of the "petals" which carry no "seed" at the base still of a bright colour, while those that are "seeded" have turned dark reddish-brown.

FIG. 10.—Photograph, taken in October, of a part of a hop-garden *where the hops were not picked on account of "Mould"*—

special dose given to the lowermost leaves. One good early sulphuring frequently prevents a bad outbreak of "mould" later in the season, and should never be omitted.* If "mould" has been noticed in the garden in the previous season, the knapsack sulphuring should be given once a fortnight until the lower leaves have been "stripped" off. Where a bad outbreak of "mould" has occurred during the previous season in the garden, or where the thoroughly bad practice has been followed of leaving "mouldy" hops unpicked, applications of sulphur with the knapsack pump, starting at the beginning of May, should be given regularly at intervals of a fortnight until the bines are high enough for the horse-sulphurator to be used. The number of applications necessary later in the season must of course depend on the extent and character of the outbreaks of "mould," on the weather conditions, and on the amount of "bine" in the garden. It is dangerous to tolerate patches of white "mould" at any time in a garden, as under certain weather conditions favourable for its propagation the mildew spreads with great rapidity and if this coincides with the period when the hop-plant is in "burr" or just in hop, irreparable damage may be done. Up to the time the "burr" appears any white "mould" in the garden should be promptly dealt with by sulphuring. It is the practice of many of the most successful hop-growers to sulphur the hops when in burr, not only as a preventive of "mould" but in the belief that the sulphur acts in some beneficial way, causing the "burr" to set into hops quickly. Generally speaking, no further sulphuring is necessary; should, however, "red mould" appear, applications of sulphur must be given until the hops are approaching ripeness.

In sulphuring with the horse-machine it is considered a good practice—since the sulphur is so light that it drifts in

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* A striking instance of the efficacy of early sulphuring may be mentioned here. At the East Malling Research Station, in Kent, a new variety of hop, "The Foundling" (see this *Journal*, Vol. XXII, p. 136 (1915)) has been grown, amongst others, in the Hop Variety Trials. "The Foundling" has proved to be so specially susceptible to "mould" that nearly all the growers who have been testing it have abandoned its cultivation. The treatment of the hops at East Malling for the years 1918-20 has been as follows: *1918*, 5 applications of sulphur, viz., knapsack, end of May, early June, July 21; horse-sulphurator, Aug. 10, Aug. 17; *1919*, 3 applications, viz., knapsack, early June; horse-sulphurator, July 24, Aug. 16; *1920*, 2 applications, viz., horse-sulphurator, July 16, second week in August. In 1918 and 1919 there was no trouble with "mould." Mr. J. Amos, Manager Recorder, writes: "In 1920 the early sulphuring was omitted, which I must admit was a mistake, for I noticed that the hops were more 'mouldy' than in the two previous years, as was also the case in 1917 when no early sulphuring was done. I shall make a point of having the early sulphuring done annually in future."

the air over several alleys—to take the machine down every second or third alley through the garden in the first operation, and then on subsequent occasions to go down the alleys previously missed. The sulphur will always readily adhere to any spots of "mould," but if a slight dew is present, it will stick better to the hop-leaf; absence of wind at the time of the operation is highly desirable, and such a condition is most frequently obtained in the early hours of the morning.

The purest "flowers of sulphur" should be used in all the operations, and such adulterated forms as "green sulphur," "black sulphur," "sulphur vivum" should be strenuously avoided.* Recent evidence gives ground for believing that sulphur does not act in a gaseous form, and that direct contact of the mildew with a particle of the sulphur is necessary for its destruction. Contrary to general belief, the heat of direct sunlight is not required in order to make sulphur efficacious in killing "mould." The writer has observed repeatedly in experiments that when a particle of sulphur adheres to the mildew, a slow shrivelling up of the fungus takes place, even when it is kept continuously in the shade (*Fig. 9*). In order to get the best results in sulphuring against "mould," the observance of two points is essential: (1) the "flowers of sulphur" must be of a brand guaranteed to be pure sublimed sulphur and free from admixtures, and (2) it must be in a condition of very fine, dry, dust-like particles free from lumps or "caked" masses. If the sulphur has become "caked" it must be passed through as fine a sieve as possible. The finer the particles the greater will be the number of points of contact, and a quicker and more thorough destruction of the mildew will be the result.

There seems little doubt that in wet weather "mould" is not kept under satisfactorily by "flowers of sulphur," probably because of the removal of the latter by the rain. Some growers use in dull or wet weather a solution of "liver of sulphur" (polysulphides of potassium or sodium). The strength usually advocated is from 1 to 2 lb. of "liver of sulphur" to 100 gal. of water or of "hop-wash." Experiments have shown† that a "liver of sulphur" solution of this strength does not kill hop-"mould," even when used with 10 lb. of soft soap to the 100 gal. of water, and that from 3 to 4 lb. of "liver of sulphur" is

* A sample of a much-advertised brand of "green sulphur" contained only 25 per cent. of sulphur, while the other constituents (including sulphate of lime (gypsum) 40 per cent.) were of no known fungicidal value.

† *J. V. Eyre* and *E. S. Salmon*, in *Journ. Agric. Science*, VII, 473 (1916).

required—a strength which would cause too serious a " scorching " of the hop-plant in summer. In common practice, the " liver of sulphur " solution is applied with the wash (usually soft soap and quassia) that is being used against the " greenfly " (*Aphis*). If this wash contains a higher percentage of soft soap than 10 lb. to the 100 gal., it is possible that good results are obtained in checking, if not killing, the " mould," since it has been found that " liver of sulphur " solutions become more potent when used with greater amounts of soft soap. It is questionable, however, whether sufficiently strong solutions of " liver of sulphur " (with soft soap) to kill " mould " could be used on hops either when in " burr " or just before (when the " pin " is showing) without causing serious " scorching " injury.* Strong solutions of " liver of sulphur " and soft soap, or the lime-sulphur wash (1 lb. of the concentrated wash to 29 gal. of water) can safely be used on the hop-leaves early in the season, but except in special circumstances their use would not prove economical. It is quite certain that at present " flowers of sulphur " must be regarded as the one safe and certain remedy against " mould."

(*To be concluded.*)

* The same danger would attend the use of the lime-sulphur or the ammonium polysulphide wash.

POULTRY RESEARCH.

AN URGENT NEED.

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ONE need not be particularly perspicacious to recognise the current vigour in and expansion of the poultry industry. The forthcoming World's Poultry Congress is in itself a clear indication of the rapid development that has taken place during the last few years; while the part Great Britain is to play at the Congress demonstrates the enthusiasm of the poultry specialist in this country.

When development is so obvious, and when poultry-keeping is becoming so popular, the question naturally arises: Is science taking an adequate share in the development? So far as the United States of America is concerned, the answer is that science is undoubtedly affording a very considerable and present help. The paper read by Mr. Edward Brown at the 1920 Harper-Adams Conference alone shows this. But the answer as applied to Great Britain is not so satisfactory. Work in poultry research has certainly been done, and is being done, but it may be reasonably affirmed, not to the extent nor in the organised manner that is so desirable. Credit must be given to the few who are applying time, thought and energy to the elucidation of problems relative to heredity, diseases, and the like, but workers in the enormous field of research are all too few. This is the more to be regretted because the machinery by which knowledge can be brought to those who are willing to apply it is in existence. Poultry lecturers there are in plenty, but they are only able to instruct the poultry-keeper up to the point at which present knowledge ends. Poultry investigators, on the other hand, are far too few, while their research is too sporadic. This is likely to remain so until adequate opportunities are given to those who would fain specialise in poultry research, but who must, for the present, make such research subsidiary to their main line of work. So many problems are clamouring for attention that the chance investigator is discouraged from embarking upon research while he sees little, if any, probability of being able to pursue it in a manner likely to lead to satisfactory results. However small the corner of the field upon which he casts his eye, he soon perceives that either he or someone else must attack areas outside that little plot.

Factors controlling Artificial Incubation.—There would be little difficulty in indicating problems the solution of which would greatly benefit the poultry industry. All those questions that centre around artificial incubation immediately suggest themselves, and it is, indeed, fortunate that a start has been made in this direction. So far as present indications go, Professor Chattock is in a fair way of revealing some of the factors controlling successful artificial incubation. Being artificial, it is reasonable to surmise that the factors are many, and it may be safely predicted that, the deeper the problems are probed the more widely will their ramifications be found to extend. New questions are bound to present themselves, but while these are waiting for answers, those solutions that have already been arrived at are available for practical application.

Avian Reproduction.—The phases of reproduction prior to incubation also offer wide scope for the investigator. While there are principles of the physiology of reproduction common to all the higher animals, there are many features of reproduction peculiar to birds. Obviously, phenomena long recognised and subjected to investigation in mammals must of necessity be absent in oviparous animals; and phases of the reproductive act that are of first importance in birds are inconspicuous in mammals. Seeing that the ovum of birds, as first formed in the ovary, is so small, it is evident that the formation of the other components of the egg—the yolk and the white—and the laws governing their formation, must always stand first in economic importance. The periodic production of relatively enormous quantities of albumen by the fowl has no exact parallel in the mammal. Clearly, then, the general and mammalian physiologist can scarcely be expected to give special attention to such processes, though they lie at the very root of success in the poultry industry. Not that the physiology of avian reproduction has been entirely neglected: much attention has been paid to it by American investigators. Yet no one with a knowledge of research workers' publications can escape the conviction that what has been discovered in this direction is but a tithe of what remains to be discovered before any practical application of the knowledge is possible.

Problems of Reproduction.—With the problems of reproduction as affecting egg-production, those of heredity are inseparably connected. The utility poultry keeper is probably not very interested in fine distinctions of plumage or in the size and shape

of the comb, but he is anxious to learn anything concerning the inheritance of factors that affect the number and size of the eggs, as well as the fattening qualities of the bird. Egg-laying trials serve an exceedingly useful purpose, but they do not necessarily throw a searching light on the subtler aspects of heredity. It is not difficult to understand that the trials can hardly be conducted with that regard for scientific precision demanded by the student of heredity, and that, therefore, more rigid control, and the recognition of precise rules of experimentation, may be regarded as necessary for the discovery of facts upon which laws may be formulated.

Pathology of Reproduction.—Reproduction, moreover, has its pathology. Not by any means of trifling economic importance are those obscure disturbances of the reproductive organs which, though not generally recognised as actual diseases, are yet sufficient to lead to faulty egg-production. These, too, require investigation.

Research in Poultry Diseases.—In the province of pathology and bacteriology, it is impossible accurately to estimate the benefits that would accrue to the poultry industry from discoveries arising out of research. There can be no question that the benefits would be many, and we may obtain some idea of them by a review of any one of the recognised diseases, as well as by a summary of the confessed gaps in current knowledge respecting its etiology and control. For such a review and summary almost any disease would serve, but an instructive example might be found in a disease of which few poultry-keepers have the good fortune to be ignorant. I refer to that disease or group of diseases known by a multiplicity of names—roup, diphtheria, bird pox, &c. In the forefront of many questions stands that of Cause. Is there one main factor? Or are there many? If it should be determined that there is only one causal agent, then how is it that such a gamut of manifestations can be induced? When these and many other doubts of a like nature have been cleared, there will arise an inquiry into the best and surest method by which the disease or diseases may be combated and controlled.

Carriers of Disease.—There is also the matter of "carriers." It is recognised that apparently healthy mammals may be "carriers" of diseases, and in avian pathology it is also recognised that an apparently healthy pullet may be a "carrier" of the virus of bacillary white diarrhœa. It is probable that fowls

may be " carriers " of other diseases, but investigation on scientific lines can alone prove this.

Poultry Research.—That pathological and bacteriological research will always be fruitful, in varying measure, is beyond question, and it cannot be doubted that any discovery in avian, no less than in mammalian, pathology will inevitably show that there is something further to seek. There is no finality in pathological research any more than there is in any kind of biological research. Those who are following modern thought in Medicine know that recently a change has crept into the conception of the causation of diseases due to bacteria. Time was when it was considered sufficient to recognise two factors in disease—the tissues of the animal attacked, and the attacking micro-organism. Now, however, experiments have hinted at the possibility of a third factor—or " third partner in disease," as it has been called—acting on the animal tissues and breaking down their defence, thus permitting the micro-organism to exert its pathogenic power. When the precise nature of the " third partner " has been disclosed, and the means of nullifying its effects have been devised—thus putting a further restraint upon the activity of the pathogenic organisms—research will proceed to an inquiry into the still more efficient control of the causes of disease. Whatever advance is made in pathological knowledge in general, will be possible of application to the control of avian diseases. Clearly, then, facilities and opportunities for the application of general knowledge to the special problems of poultry diseases cannot fail to lead to beneficial results.

While poultry research has a wide field in the investigation of diseases concerning which something, at least, is already known, it has an even wider field in the discovery of the true cause of many diseased conditions not yet clearly identified. Is it not true that even the poultry-keeper of wide experience occasionally encounters a condition that, in spite of his long acquaintance with the frailties of domestic birds, he has not previously seen. and to which he cannot give a name? The pathologist who has made a special study of avian diseases is often in the same position.

Among the numerous investigations that are awaiting the attention of research is that dealing with the action of drugs. From the very limited observations made, it is evident that the effects of drugs on birds cannot be predicted with certainty. This is not surprising, for it is well known that different species of mammals exhibit variation in their tolerance to toxic drugs,

from which it might be surmised that drugs would also affect birds in varying degree. Gallagher's experiments, though few in number, are sufficient to show that poultry have a distinct tolerance towards some drugs, while they are sensitive to others. Though it would be unwise to draw definite conclusions from experiments that are admittedly only preliminary, it is at least permissible to say that they demonstrate the need of investigations on the safety-point of solutions used as drinking-water.

It is unnecessary to detail all the directions in which profitable research might be undertaken, but passing reference may be made to the necessity for systematic inquiry into food values. In mammalian physiology, an enormous amount of work has been done, and is being done, to discover the most economical and most productive foods, and certain laws of nutrition have been formulated. But in avian physiology the subject has not received nearly the amount of attention it deserves. Discoveries in mammalian dietetics cannot always be applied to birds, because of differences in metabolism and outstanding differences in the physiology of reproduction. That the kind of food—apart from its quantity and admixture—has a marked influence upon the egg may be taken for granted, for it is well known that the colour of the yolk can be altered by the administration of certain foodstuffs. If, then, the colour can be affected, why not other properties? And why should not the white of the egg be affected as well as the yolk? Doubtless something of value could also be discovered from more extensive research on the question of insect proteins as a component of the diet of poultry. It has even been suggested that insect protein may have an influence on susceptibility to disease. But the whole subject of dietetics is very closely associated with liability to, and even production of, disease.

If, then, it is held incontrovertible that poultry research is necessary and would lead to results of economic importance, it may be asked: Under what conditions should it be prosecuted? It is possible that some would suggest a large central institution wherein all forms of research might be conducted by a specially trained staff, who would disseminate reliable information to those engaged in the poultry industry. There is much to be said for what may be called a clearing-house of knowledge, from which the poultry-keeper could obtain the information he desires, if available. But it is not so certain that centralisation of research would be altogether a good thing. There is a strong possibility that the workers, being isolated and not in contact with wider

and more general biological problems, would have their outlook narrowed. It seems probable that better work would be done in places where problems relative to mammals were also being investigated. Breeding experiments would be more fruitful of useful data if they were conducted alongside investigations bearing on the same questions as applicable to animals other than poultry. Investigations relative to dietetics could scarcely be profitably separated from the work of existing nutrition laboratories; nor would it be altogether wise to separate the study of avian diseases from that of mammalian pathology. On careful consideration, it appears probable that in practice the most satisfactory way of fostering poultry research will be found to be by encouraging existing institutions to extend knowledge that can be disseminated by a central organisation, to which the poultry-keeper may look for information, guidance, and advice.

NOTES ON POULTRY-KEEPING.

THE development of egg production has to some extent operated against the revival of the table poultry industry, and at the present moment this is very apparent. With the exception of small supplies of "petits poussins" practically the only English poultry now reaching the markets are old birds. Fortunately for the consumer, American supplies of frozen chickens of very good quality are available. By the time these notes appear spring chickens should be ready for the markets in appreciable quantities, and poultry keepers are warned against holding back their supplies too long. The demand is for a chicken weighing 2 to 2½ lb., and although young birds of larger size may be even more favourably received it is seldom advisable to hold them over several weeks in order to attain this weight, since by so doing the best trade and the higher prices per lb. are frequently lost. Although the cost of feeding stuffs has fallen, the prices realised for table poultry are good.

In many instances, particularly when there is a lack of accommodation for the growing chickens, the poultry keeper is well advised to market his young cockerels as "petits poussins." These small birds sent to the market alive weigh from 10-12 oz. when, at the rate of 2s. 8d. to 3s. per lb., there is a fair margin of profit.

An indication of the comparative position of poultry foods at present, compared with this time last year is given by a comparison of the average wholesale prices of the staple poultry foods in London in corresponding weeks of 1920 and 21 :—

			Week ending			
			April 7th, 1920.			*April 6th, 1921.*
			£ s.			£ s.
Oats	per 336 lb.	...	3 0	...		2 4
Maize	„ 480 lb.	...	3 19	...		2 16
Middlings	„ ton	...	13 10	...		10 0
Bran	„ „	...	13 10	...		8 0
Barley meal	„ „	...	25 10	...		15 10

Apart from the considerable reductions shown in these figures the quality of the offals in particular has vastly improved. Although figures for ground oats and proprietary foods largely used in chicken rearing during the early stages cannot be given, these will generally be found to have fallen at least proportionately, whilst there is an even greater improvement in quality.

Chicken Rearing.—By May a large proportion of the chickens have reached a stage when the pullets and cockerels will thrive much better if separated. Some difference in the feeding should be observed; young cockerels if kept in a soft and well-fed condition will require little if any fattening provided they are separated from the pullets, and they will then be ready for table at from 10-14 weeks old. They may be kept upon a restricted range, in a grass pen for preference, whereas the pullets will grow and thrive better with free run and a less generous diet.

Sussex ground oats or barley and maize meals with a due proportion of middlings should be given to cockerels in a wet mash twice daily, with a feed of wheat at night time. One feed of wet mash with a small feed of wheat at mid-day and a liberal feed of wheat at night will suffice for the pullets on a free range, but an additional wet mash is necessary if the range is limited. As an alternative under these conditions dry mash may be used in place of the wet mash.

Young Turkeys.—Unless the young turkeys have the range of meadows and hedgerows with access to nettles and other wild green stuffs of which they are very fond, troubles are likely to arise. The too free use of starchy foods in the dietary of turkeys is a frequent cause of loss, and an abundance of green food is essential. Insect life is also needed, and the provision of a substitute when the birds have a limited run is more difficult than in the case of chickens and ducklings. Young turkeys do not readily eat fish meal, but granulated meat of good quality and free from bone can be given, though the use of freshly cooked meat, bullock's liver and lights, finely chopped, is much to be preferred. Middlings, Sussex ground oats, and maize meal can be used—the two latter in moderation—and boiled rice if mixed with the meat. Practically 50 per cent. of the bulk of the food consumed by young turkeys should consist of fresh green stuff.

Ducklings.—The rapid growth of ducklings renders them particularly attractive to the rearer of table poultry. They are ready for market from 3 to 4 weeks earlier than a chicken and can be raised upon smaller spaces. Boiled rice constitutes one of the most valuable foods, but this cannot be considered economical at the present price. Middlings with maize and barley meal or wheat meal with 10 per cent. of fish meal should be used up to 5 weeks of age, after which the quality

of the flesh will be better if maize and fish meals are omitted. Fresh meat offals thoroughly cooked and including the fat should replace the fish meal. Boiled nettles, using the tea for mixing the meals, should be given at least once weekly from the time the ducklings are a month old. At this age boiled wheat forms a useful variety to the meals used, but uncooked grain is not economical for fattening ducks.

Adult Stock.—The use of nettles for adult poultry stock at this season is greatly to be recommended. With the advent of warmer weather many of the laying hens suffer from the generous feeding given during preceding months to maintain production. Several mashes of young nettles boiled to a pulp and mixed with the wet mash will have a very beneficial effect.

THE NOMENCLATURE OF AGRICULTURAL PLANTS.

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To anyone who has the future prosperity of British Agriculture at heart, one of the most hopeful signs of the times must be the fact that the farming community, hitherto noted for its extreme conservatism, is beginning, under the stress of modern conditions, to discard the idea that the ways of its fathers are invariably the best, and to demand that new methods of cultivation, new fertilisers and new varieties of plants shall be provided for its use.

Valuable as will be the ultimate effect of this new spirit, it has also its dangers, for what is "new" is not always an improvement on the old, nor is what is termed an "improvement" always what it purports to be. As in all matters, so here, demand has stimulated supply, and never has there been such a number of "new" and "improved" varieties of our different agricultural plants put on to the market as has been the case during the last few years, and every year that number increases.

This, in itself, is all to the good, for, as time goes on, it becomes more and more evident that there is no one variety of any agricultural plant which is ideal for all conditions of soil and climate found even in a small country like the United Kingdom. In fact there is room for any number of varieties of any species; and any variety which can be shown to be particularly adapted to any one district has, in fact, justified its existence. It is certain, however, that among all the named varieties now on the market, there are a large number which could, and should, be eliminated as being either identical with one another, or as being distinctly inferior, under any conditions, to their brethren.

Present Situation in the United Kingdom.—Though everyone with any knowledge of the subject is convinced of this superfluity, it is obviously difficult to produce any large amount of evidence concerning the extent of the trouble, for no trials in any country (except in the case of potatoes, fully dealt with later) have ever been made on a sufficient scale to afford

concrete proof, and where no conclusive evidence is forthcoming, it is impossible, on account of the proprietary interests involved, to give instances, however strong the presumptive evidence may be.

Wheat.—The above should be borne in mind when studying such a brochure as "Dunns on Seed Wheats"—the most complete modern catalogue of wheats which has fallen into our hands—for it is obvious that a publication of this nature cannot but be absolutely tied down to accepted fact. Even so, concerning the list which it contains of over 425 names, it says: "It is not suggested that they are all distinct varieties. Essex Rough Chaff, Kentish Red Chaff, Square Head's Masters have at least a dozen names, each in different localities." Seventy-five names are mentioned as being used for varieties still grown in the United Kingdom, but from the notes given it is obvious that they cannot represent over (but probably far less than) 60 varieties.

An additional complication arises out of the use in many cases of one name for several varieties; for example, there are white chaffed and red chaffed wheats both known as Browick, and it is the common practice to call all bearded autumn-sown wheats either Rivetts or Cones, and they include both red and white grained varieties.

Oats.—There is the same confusion in the case of oats; it is difficult to say how many different "varieties" are in existence, none of which show any visible difference from "Abundance." Mr. C. W. S. Marquand, of the University College of North Wales, Aberystwyth, states that, as a result of a study of a very large number of samples, he has come to the conclusion that many so-called "varieties" are *morphologically* indistinguishable, but that he is not yet in a position to express an opinion as regards their *physiological* identity.

Grasses and Clovers.—Here the position is somewhat different; the number of varietal names is small, but there is a profusion of strains with purely local, and probably mythical, reputations. Only a very small number are the result of conscious effort towards improvement, nor have their claims ever been submitted to crucial test. Mr. S. P. Mercer has already pointed out the confusion which exists where Red Clover is concerned, enumerating the following names which are in use without any strict adherence to any system by which it would be possible to tell whether the strains were of ordinary Broad Red, or of the true late-flowering type. "The names,

Red Clover, Cowgrass, Giant Cowgrass, Perennial Red Clover, Cow Clover, Single-Cut Cowgrass, Double-Cut Cow Clover, Late-flowering Red Clover (and probably others) appear to be used very much according to the taste and fancy of the user."* There is also much confusion arising out of the promiscuous use of the term "Wild white clover."

Vegetables.—In the case of vegetables it is probable that the "orgy of synonyms" is more marked than in any other group of plants. Of the thousands of names of peas at present on the market there are probably less than 100 varieties, and these in turn include probably less than 20 types. Cabbages, turnips and beans also suffer from a multitude of unnecessary names.

Potatoes.—For more concrete evidence, it will now only be necessary to describe the state of affairs where potatoes are concerned. Here one is on safe ground, for, as stated above, this is the only crop which has been systematically and authoritatively dealt with in relation to synonymity.

As a result of the widespread importance attached by all those interested in the potato crop to the Ministry of Agriculture's annual trials for Immunity from Wart Disease held at Ormskirk, perhaps nowhere in the world are such a great number of varieties grown in such a limited area or under such uniform conditions. In 1915 the late Mr. John Snell, M.B.E., B.Sc., started to make records of synonymous varieties sent for test, and, since 1919, annual reports have been published on this subject.†‡ In the 1919 report† Mr. Snell suggested the several ways in which synonyms could arise, viz.:—

(1) The re-naming of varieties for trade purposes.
(2) The giving of a new name to a selection from an old variety, even though the selection may be indistinguishable from the variety.
(3) The propagation and naming of promising "rogues" found in fields of another variety, on the assumption that they are "sports" or "mutations."
(4) The stock of a new variety passing into the hands of two different introducers, each of whom names it.

* Report on A Survey of the Principal Seed-Growing Counties of England, Wales and Scotland (to be issued shortly by the Ministry of Agriculture and Fisheries).

† Supplement No. 18 to the *Journal of the Board of Agriculture*, March, 1919.

‡ Ministry of Agriculture and Fisheries. Miscellaneous Publications, No. 28.

(5) True seedlings arising, which are identical with older varieties, or with other seedlings.

Though interesting, it is not necessary to dwell on this branch of the question.

In 1919, the work was transferred to a Committee, and in 1920 the National Institute of Agricultural Botany took over the responsibility of the appointment of this Committee, and the report for this year was written by its Chairman, Dr. Salaman, and published by the Institute.* For fuller details concerning the important work carried out since 1915 the reader is referred to the three reports mentioned. It will suffice, here, to confine our attention to synonymity among the named "varieties" submitted each year, ignoring unnamed seedlings which have, or (usually) have not, proved themselves to be novelties. The total given for each year consists of named stocks of potatoes which purport never to have been previously tested at Ormskirk.

	Total.	*Synonyms.*	*Percentage.*
1915	90	24	27·77
1916	81	21	25·92
1917	43	9	20·93
1918	93	39	41·93
1919	105	64	60·95
1920	135†	92	68·15
	547	249	45·52

This would seem to show that the trouble is on the increase.

It may be objected that the mere fact of entering potatoes for trial cannot be taken to mean that it is intended to put them on the market. This argument would certainly hold good for unnamed seedlings, but these are excluded from the above figures, and it seems fair to argue that breeders or producers do not, as a general rule, name their productions unless they have some definite idea of submitting them to the public.

As a result of the publication of these findings, very few, if any of the above synonymous stocks have actually been sold commercially; this only emphasises more strongly the immense value of such a check, and how desirable it is that something of a similar nature should be undertaken in the case of other crops.

Evidence of the conservatism of the findings is supplied by

* National Institute of Agricultural Botany, "Report of the Potato Synonym Committee, 1920."

† Excluding stocks too weak in growth, or too mixed to be judged.

Mr. Findlay,* who enumerates 148, among the potatoes which he has himself tested, as being synonymous with either Duke of York, British Queen, Abundance or Up-to-date. Of these, 48 have also been grown at Ormskirk, and in 38 cases there is agreement both as to synonymity and type. A larger discrepancy might have been anticipated, for at Ormskirk the Synonym Committee does not pronounce a stock to be a synonym save with the concurrence of every member (six in 1920); thus, at Ormskirk there is a greater likelihood of a stock being given the benefit of the doubt than where, as in Findlay's case, the decision rests with a single judge.

Harmful Consequences.—Such chaos as has been shown is obviously bad. It prevents the raiser of a good new variety from reaping the full value of his discovery, as the name he selects will be lost amongst the many new names that are continually appearing. It makes it necessary for the seedsman to list and stock many so-called different varieties of the same kind of seed whereas probably half the number would be sufficient so far as any real difference in the varieties is concerned. It also entices the grower to purchase seed because it has an attractive new name, whereas seed which will produce exactly similar crops could in many cases be purchased at probably a lower price under the name of its parent.

It is not implied that wilful misrepresentation is habitual, or even common, among British Seed Producers or Dealers, but a very small minority can do a great amount of harm. In general, our present position must be attributed to the complete lack of any means by which a variety can be submitted to adequate comparative test before it is put on to the market. No single firm could possibly undertake the highly technical tests which would be necessary to ensure complete knowledge concerning its productions, and even if the attempt were made, such a firm would only penalise itself to the advantage of its less careful competitors.

Nevertheless immediate action is called for. The present situation is undesirable, as worthless or inferior varieties are being kept alive when they deserve to die, and they are continuing to occupy land which should be growing more valuable productions.

Remedial Measures Abroad.—It is recognised that the evidence given concerning our British crops is not conclusive, but

* Wm. M. Findlay, "Potato Synonyms," *The Scottish Journal of Agriculture*, April, 1920, pp. 202-207.

it only requires a short investigation into the action being taken in foreign countries to convince us of the seriousness with which they view the present situation. In every case where any attention has been paid to the matter, it has been decided that the facts have justified the adoption of some scheme by which the trouble may be diminished.

Germany.—For the general system of seed improvement, the reader is referred to the *Journal of the Board of Agriculture* for June, 1909. Crop nomenclature is controlled by a Committee of the German Agricultural Society, whose main activities consist of the Registration of Pure Bred Seeds, the "Recognition" of stocks of superior varieties, variety trials, &c.

Registration of all plants of agricultural importance in the Official Register is permitted on submission of satisfactory evidence, derived from independent trials, that an improved variety has been produced, but proof must also be given that this improvement is the result of conscious efforts carried out through a series of years on the stock in question. A sub-committee of experts decides the eligibility of stocks, and admission gives the producer the exclusive right to describe his seed as "entered in the Pure-Bred Seed Register of the German Agricultural Society" and to use a legally protected trade-mark. Mr. E. S. Beaven* has already pointed out of what great value such a system would be in England, but so far no steps have been taken in this direction.

"Recognition" is granted to the seed-crops of Members of the German Agricultural Society after the growing crop has been inspected by experts of the Society, who must satisfy themselves that it is a pure sample of a variety of proved worth, that it is being grown under favourable conditions, and that harvesting arrangements are satisfactory. Recognition only applies to the actual crop inspected.

All registered seed has also to be "recognised," but recognition is also open to growers (who are not the actual breeders) of seed of first-class varieties, and to breeders whose varieties have not gained admission to the register.

It is obvious that fictitious novelties are excluded, by the above conditions, from both registration and "recognition."

Variety Trials are carried out on an extensive scale all over Germany, not only by the Society itself, but also in conjunction with other Agricultural bodies. The trials are conducted on a

* *Journal of the Royal Agricultural Society of England*, Vol. 70, pp. 119–139.

uniform plan, and the results are published by the German Agricultural Society.

It may be remarked that trials are an essential part of any scheme, and the whole subject is dealt with below.

Denmark.—When reviewing Mr. Faber's book, "The Forage Crops of Denmark," in a previous number of this JOURNAL, one of the present writers drew particular attention to that portion which explains how, in Denmark, there is practically no sale for Root-seed unless it has shown its superior value in independent field trials. The "Guarantee of Genuineness" now furnished by Danish Seedsmen also was the subject of special comment. So great has been the success of these two movements that, as far as Roots are concerned, all confusion in nomenclature has been completely eradicated; it is now intended that all other agricultural crops shall receive similar attention.

Whether "Guarantees of Genuineness" can ever be introduced into this country is a question which only the Seed-trade itself can decide, but it is worth pointing out that in Denmark the system originated on the initiative of the trade, and has become more and more popular with them ever since.

Holland.—The "Society of Agriculture of the State of Holland" undertakes the inspection of crops at all stages, from sowing to marketing, and issues a guarantee of seed which comes up to the requisite standard.

The farmer who desires to sell seed under this guarantee must obtain his original stock from a source recognised by the Society—either from a pedigree-seed producer of unimpeachable reputation, or from stocks previously approved by an Agricultural Society providing satisfactory guarantees of their value. The seed should reach the farmer in sacks sealed by the producers, when he must notify the Chief Inspector of the Dutch Society of the date and place of the proposed sowing. The Inspector verifies the origin of the seed and notes the land on which it is sown. The crop is subsequently examined just before harvest by an inspector and by two experts nominated by the Society, and is valued on a scale of points, as follows:—

Trueness to strain and variety	max. 30	points.
Uniformity of height of plants	,, 20	,,
Absence of weeds	,, 5	,,
Absence of disease...	,, 15	,,
General impression	,, 30	,,
	100	

For guarantee, the points gained must exceed 80, and the crop must earn 3/5 of the maximum under each heading. The finding of the Committee must be unanimous. Before the guarantee is actually given, the Society must be informed of date of harvest, of thrashing and of cleaning, each of which must be done in such a manner that admixture is precluded. The harvested seed is examined critically by the inspector, and if the result is favourable, the bulk is placed in bags and sealed with the initials of the Dutch Society, and with a number corresponding to that in the Society's register. A sample is taken and retained for reference after a small quantity has been sent for test at the Official Seed-Testing Station, the report of which is published in the journal of the Society. After this the seed can be sold as "Guaranteed."

Other European Countries.—As far as can be ascertained, the remainder of the European countries have devoted but little attention to the problem, and have so far confined their activities to an attempt to crowd out inferior varieties by propaganda in favour of those of proved worth, and by organising seed-growing societies among farmers through the agency of which seed of good varieties is disseminated throughout the country. These activities, though valuable, do not touch the root of the evil, and can only be regarded as auxiliary measures.

Australia.—A Seed Improvement Committee of the Commonwealth Advisory Council of Science and Industry was set up in 1917. Its chief terms of reference are:—

"To deal with (1) the nomenclature of cultivated varieties of farm crops, (2) the elimination of undesirable varieties of crops."

Wheat is the first crop to receive attention, and it was decided that the first thing to be done was "to publish a detailed description of every variety (of wheat grown in Australia) which can be taken as a standard, and to which any grower or breeder can refer in case of doubt." As a result of this, a bulletin containing a provisional classification and key has now appeared, and it is proposed to add to this from time to time. Other measures will follow in due course, but their nature and scope have not been published. Classifications or descriptions of wheat varieties have also been produced in South Africa and India.

United States of America.—In America, though it is widely recognised that the nomenclature both of agricultural and garden

plants leaves very much to be desired, little has been done by Federal legislation to bring about improvement. It appears that the truth is occasionally published concerning some of the most flagrant cases in which varieties are being sold under incorrect varietal names. but, in general, unless there is fraudulent exploitation, even this action is seldom taken. Even where such facts are published, little benefit can result, for in no cases are the names of the offending traders given save in the unique instance where such action is enjoined by Federal legislation. This last is in connection with the adulteration of certain grass-seeds where the law definitely directs that the names of the offenders shall be published.

Under the auspices of the United States Department of Agriculture, systematic botanists started, in 1903, to compile a classification of the wheats of the country, but so great was the confusion which they found to exist that the project had, temporarily, to be abandoned. This work has now been resumed by Messrs. Ball & Clark, who, as a preliminary step, presented a paper before a meeting of the American Society of Agronomy. They commence the paper by giving numerous examples of the chaos prevalent in the nomenclature of this crop, and then set forth a proposed code of nomenclature for consideration and adoption by this body as representing the interests concerned. A complete set of rules is set out, which even go so far as to control the type of name to be adopted by the originator, discoverer, or introducer.

Pure-line selections, hybrids, &c., which have superior merit, even though not distinguishable by external characters, are eligible, but unfortunately, the basis on which admission would be granted or refused in such cases is not explained.

Were it proposed, in England, to exercise an absolute control over nomenclature, these regulations would demand detailed study, but the present time is not auspicious for such a plan, nor does it appear desirable to go to this extreme until other means have been tried.

Apart from any action by the Federal Government, each State can take its own line in matters of Seed Control, and all except 15 have done so. Their general object is to make compulsory the labelling of all seed sold within the State, such labels usually have to state the kind of seed, the name and address of the seller, the purity, the germination, the place of origin and the percentage of specified noxious weed-seeds. A heavy fine is imposed should any information on the label be proved to be false.

To turn from agricultural to garden plants, much valuable work has been done lately. At the Annual Convention of the Vegetable Growers' Association of America in 1919 a committee was appointed to study the problem of vegetable nomenclature. A further committee with a similar purpose was appointed by the American Seed Trade Association at their 1920 Annual Meeting. These two committees held a joint meeting in October last at which certain lines of action were decided on which give promise of real progress in the solution of this difficult problem.

Previous to this joint meeting a questionnaire had been issued to members of the Association asking (1) whether they were in sympathy with an attempt to standardise the names of vegetable varieties, (2) whether they had any points to suggest in connection with form of name, spelling, provision for the identification of private strains of standard varieties, &c., (3) whether they would supply the Committee with a list of the varieties definitely understood to be renamed standard varieties, and also a list of the new varieties introduced by each firm which had been generally accepted as new varieties, (4) whether a transition period of one, two or five years should be adopted as the period during which renamed varieties should be followed in brackets by the Standard name, and (5) whether they would be prepared to forward trial samples of all new varieties to be tested and registered at an official trial ground at least one year in advance of their public introduction.

The replies to this questionnaire were very satisfactory and encouraging.

The joint committee decided that one of the first problems which presented itself was the necessity for collecting complete information with regard to the trade names and comparative market quality of the different vegetables and their varieties. It was clear that to obtain these particulars the assistance of a wide circle of competent persons would have to be enlisted. The Committee therefore grouped vegetables according to their natural relationship and twenty-one sub-committees of the leading authorities in the seed-trade of America were suggested as group committees. A plan of work was mapped out for these committees.

The joint committee also drafted a suggested code of vegetable nomenclature modelled on the code adopted by the American Pomological Society.

In addition to the controlling of the type of name to be adopted, the code lays down that there shall be a Board of

Registration (it is suggested that the Bureau of Plant Industry should undertake this work) whose duty it shall be to make and preserve records and descriptions of all existing valid varieties of vegetables, and to register such new varieties as may be submitted to them, provided they find them to be truly new and distinct. This Board is to have authority to issue a certificate to the originator of a new variety, and such variety is not to be catalogued or offered until such certificate has been issued.

The work of the 21 sub-committees appointed to give detailed study to certain groups of vegetables is said to be progressing in a very satisfactory manner.

Efforts are also being made to develop a system of field tests throughout the different parts of the United States, to be checked by some central committee, whereby the comparative value of strains as well as varieties can be determined.

This concludes our survey of the work being done in other countries, and not only does it confirm our contention that the situation in those countries is deemed to be so unsatisfactory as to justify drastic measures, but it furnishes us with most valuable suggestions concerning the methods which might with advantage be adopted in England towards the amelioration of our own situation.

Proposed Remedies:—

Immediate Measures.—We will first deal with the measures being taken by the American Vegetable Growers' Association just described.

There is much in this scheme which could be adopted in this country both for agricultural plants and for vegetables. Though it is essential that for the ultimate solution of the problem of nomenclature a complete system of yield and quality trials is the only possible basis, the organisation of such trials will take time, and there is a vast amount of preliminary work which can be begun forthwith, particularly in the direction of establishing an authentic list of existing standard varieties, which is a necessary preparation for the registration of new varieties. As to whether this preliminary work should be undertaken by the Ministry of Agriculture, the National Institute of Agricultural Botany or some other directing authority need not now be discussed.

In order to secure the requisite co-operation of the seed trade, any scheme for the limitation of the names of varieties should be of a purely voluntary nature.

The Directing Authority might in the first place invite all the leading wholesale seed houses to submit individual lists of the standard varieties of agricultural plants which they consider :—

(a) To have died out altogether, although the names are still " listed."

(b) To have been entirely superseded by better, new varieties.

(c) To be in no way different from, or to have degenerated to, the parent stock.

These lists should be amalgamated and submitted for the consideration of an expert committee, it being fully understood that the names of the firms submitting lists should in no way be disclosed in connection with their individual suggestions. From the amalgamated list a shorter (agreed) list might be selected and published as an " Official List of Synonyms." This would no doubt lead to quite an appreciable number of obsolete and unnecessary names of varieties being cleared off the market.

Future Measures.—Committees similar to the Potato Synonym Committee, but with wider functions, might be appointed to deal with each species of plant which is of agricultural (or market garden) importance. These committees must, however, be assisted by a most complete system of trials of yield and quality; for these physiological characters are after all of far greater importance to the grower than is any morphological feature such as beards on wheat or panicle shape of oats. It is essential that a broad view should be taken, and it should frankly be recognised that it is not of the least ultimate importance whether a production be a novelty or not unless, in some way, it is an improvement on its predecessors. From this point of view, these committees should discourage the naming of any variety or strain merely because it presents new characteristics. Merit should be the criterion, and on this proved merit such variety or strain should be granted admission to its appropriate Register, which should be kept by the organisation to whom power shall have been delegated to nominate these committees. The original entries into the respective Registers would be those existing standard varieties which had gained admission into the authentic list (mentioned above) compiled by the Directing Authority referred to above. As is the case in Germany, subsequent stocks would only be eligible on proof of conscious effort, culminating in improvement, continued over a series of years on the part of the producer.

This standard of merit obviously brings with it many difficulties. One is dealing with qualities which are not necessarily, or usually, correlated with any morphological character. No one, for example, on looking at an individual wheat plant of a variety unknown to him, can say whether its progeny will give a high or a low yield. As a result of long experience the expert can often recognise a variety and say: " This is Squareheads Master, it will give a bigger crop than that, which is Fife," but this prediction is only the result of constant trials of the two varieties, and not because any external character betrays the yielding capacity of the individual. Now it is certain that within any commercial variety there are individual stocks which possess capacity for yield, or for producing high quality grain, or for other valuable physiological qualities in a greater or lesser degree than the average, without betraying the fact except after prolonged test. The better stocks, when isolated, deserve encouragement; but if each small advance in useful physiological characters were considered to be a justification for a new name, instead of decreasing the number of names, it would be uncontrollably augmented.

There is obviously a distinction between these productions and those which combine improved qualities with morphological differences; and to mark that distinction it is suggested that the following definitions shall be adopted:—

Variety.—Any group of plants morphologically indistinguishable from one another, but morphologically distinct from any other plant or group of plants of the same species, shall constitute a variety.

Strain.—Any group of plants physiologically distinct from any other plant or group of plants of the same variety (as above defined) shall constitute a strain of that variety. The oldest known strain of a variety shall be termed the type.

It is proposed that only " varieties " as above defined should be entered into the Registers with distinct names, and that " strains " should be entered under the type name with the name of the originator or producer as a prefix, *e.g.*, " Brown's Essex Rough Chaff."

Should an originator claim to have produced a new, superior variety, it should be tested before admission to the Register, in competition with the best representative strains of at least two of the older varieties, and should only be entered as a new variety if both the above claims are proved correct.

In the case of a new strain, *i.e.*, where it is only claimed that an improvement has been made in yield, quality, or other non-botanical feature, the trial need only be made in regard to this quality against the best representative of the type to which the strain belongs, though any notable deficiency in any other good character would prevent admission to the Register.

Such trials must be carried out by experts, and would have to be repeated simultaneously on several different stations in different parts of England: the respective committees would weigh the evidence, and make their reports. These reports would be submitted annually to meetings of the interests concerned for confirmation, and would then be published. The reports might give, in addition to the mere findings, descriptions and illustrations of the varieties and strains which have qualified for the register; and a list of the original growers of the new registered varieties and strains, or of those to whom the whole of the original stock had been transferred.

The admission of strains to the Register, though essential, immediately creates a difficulty, for the fact that they are unrecognisable by eye from the other strains of the same type must tend to encourage fraud, as it would be impossible to detect the substitution of seed of inferior strains for that of the genuine article. That this form of fraud would not only be at the expense of the public, but also to the detriment of all honest traders, would suggest that the latter would have to co-operate to protect themselves. This brings us back to the Danish "Guarantee of Genuineness" which was evolved by the seed-traders themselves to meet this very difficulty in the case of roots. It would be a notable advance if this principle were adopted by traders in Britain, whose business it is to guard themselves, and to whose advantage it is to protect the public.

By the combination of trials and Registers everyone concerned, save those who deliberately make money by fraud, would be benefited; nomenclature would become rational and simple, and at the same time only the valuable productions would be encouraged at the expense of those which have no right to survive. The seed dealers would find their work simplified, the producers would, for the first time, receive an adequate return for their skill and labour, and the country would at last learn something about the crops which it grows.

NOTES ON FEEDING STUFFS FOR MAY.

E. T. HALNAN, M.A.,
Ministry of Agriculture and Fisheries.

Rationing of Stock.—Several correspondents have asked at various times, that analyses of feeding stuffs and their digestibilities might be included in these Notes. Owing to lack of space, and to the fact that such a table would necessarily be very incomplete, it has been impossible to accede to their requests. Their needs have, however, been carefully considered and it is hoped have been met by the publication by the Ministry of Miscellaneous Publication No. 32, entitled Rations for Live Stock, by Professor T. B. Wood. This publication, among other things, includes a table giving the chemical analysis and feeding value of all feeding stuffs likely to be used in farming practice, and will be found most valuable if used in conjunction with these notes. Copies may be obtained from the Ministry, price 6d. per copy.

Rice and its By-products.—The preparation of rice for human food gives rise to a number of by-products that find their way into the feeding stuffs market, either in the form of straight products or in the form of compound meals. In preparing rough rice for food, the outside tough hulls are removed and the rice kernels " polished " to give them an attractive appearance. These mechanical processes give rise to rice hulls, rice bran, and rice polish.

Rice hulls are tasteless, tough, and woody, and have practically no feeding value. Very often they contain a considerable proportion of sand or silica, and for this reason alone are dangerous to feed to stock. Owing to their unpalatability and poor feeding value they rarely find their way on to the market, except, in certain cases, in the form of compound meals. It should be unnecessary to state here, that reputable firms rarely employ this stuff as an ingredient to their meals.

Rice bran consists of the outer layer of the rice kernel and includes the germ, and should contain only a small percentage of the hulls. Such bran contains about 11 per cent. of oil and not more than 12 per cent. of fibre, and is a highly nutritious feed. It is useful for fattening steers, but should not be fed in very large quantities to dairy stock or pigs, since it tends to spoil the quality of the butter and produces soft pork.

NAME.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	40/3	400	11 5	1 6	9 19	71	2/10	1·52
" Canadian "	40/-	400	11 4	1 6	9 18	71	2/10	1·52
Oats, English "	44/-	336	14 13	1 9	13 4	59·5	4/5	2·37
" Foreign "	39/6	320	13 16	1 9	12 7	59·5	4/2	2·23
Maize, Argentine	56/-	480	13 1	1 5	11 16	81	2/11	1·56
Beans, English spring	—	—	—	—	—	—	—	—
" " winter	57/-	532	12 0	3 1	8 19	66	2/8	1·43
" Rangoon	8/-	112	8 0	3 1	4 19	66	1/6	0·80
Peas, English blue	58/-	504	12 18	2 13	10 5	69	3/-	1·61
" " dun	70/-	504	15 11	2 13	12 18	69	3/9	2·01
" " maple	72/-	504	16 0	2 13	13 7	69	3/10	2·05
" Japanese *	125/-	504	27 16	2 13	25 3	69	7/3	3·88
Buckwheat	64/-	392	18 6	1 9	16 17	53	6/4	3·39
Rye, English	55/3	480	12 18	1 8	11 10	72	3/2	1·70
Millers' offals—Bran	—	—	8 0	2 10	5 10	45	2/5	1·29
" " Coarse middlings	—	—	10 0	2 10	7 10	64	2/4	1·25
Barley meal	—	—	15 10	1 6	14 4	71	4/-	2·14
Maize "	—	—	11 10	1 5	10 5	81	2/6	1·34
Bean "	—	—	16 10	3 1	13 9	66	4/1	2·19
Fish "	—	—	21 0	7 12	13 8	53	5/1	2·72
Linseed	—	—	—	—	—	—	—	—
" Cake, English	—	—	19 7	3 12	15 15	74	4/3	2·28
Cotton seed " "	—	—	12 0	3 5	8 15	42	4/2	2·23
" " decorticated*	—	—	18 10	5 6	13 4	71	3/9	2·01
" Meal decorticated	—	—	13 0	5 6	7 14	71	2/2	1·16
Coconut cake	—	—	10 0	3 0	7 0	79	1/9	0·94
Groundnut cake	—	—	11 10	3 9	8 1	57	2/10	1·52
" " decorticated	—	—	16 5	5 5	11 0	73	3/-	1·61
Palm kernel cake	—	—	6 15	2 1	4 14	75	1/3	0·67
" " meal	—	—	—	—	—	—	—	—
Brewers' grains, dried, ale	—	—	7 12	2 7	5 5	49	2/2	1·16
" " wet "	—	—	1 15	0 12	1 3	15	1/6	0·80
Distillers' " dry	—	—	11 0	2 16	8 4	57	2/11	1·56
" " wet	—	—	—	—	—	—	—	—
Malt culms	—	—	6 15	3 6	3 9	43	1/7	0·85
Potatoes†	—	—	3 0	0 8	2 12	18	2/11	1·56
Swedes†	—	—	1 6	0 5	1 1	7	2/11	1·56
Mangolds†	—	—	1 3	0 6	0 17	6	2/11	1·56
Vetch and oat silage†	—	—	2 16	0 15	2 1	14	2/11	1·56

* Prices at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

Rice polish has a feeding value approximately equal to maize, but is rarely found on the feeding stuffs market as it has a commercial value apart from its feeding value.

Errata.—In the issue of this JOURNAL for April, p. 87, the following were stated in error:—

Line 14, "whole of the maize" should read "hulls of maize."
Line 19, "whole bran" should read "hull bran."
Line 29, "whole grain" should read "hull, germ."

Entertainment Tax and Agricultural, Horticultural, Poultry and Rabbit Shows.

THERE appears to be some misunderstanding as to the conditions under which exemption from Entertainments Duty is granted in respect of Agricultural, Horticultural, Poultry and Rabbit Shows.

The Ministry has been in correspondence with the Commissioners of Customs and Excise in this matter, and is informed by the Commissioners as follows:—

"All such Shows are 'entertainments' within the meaning of the Finance (New Duties) Act, 1916, and therefore Entertainments Duty must be paid unless the Commissioners of Customs and Excise have granted a Certificate of Exemption.

"Where it is desired to claim exemption, an application must be made to the Commissioners of Customs and Excise, Custom House, London, E.C.3, not less than seven days before the Show, accompanied by copies of the Rules and last Balance Sheet of the Society and Programme of the Show.

"If a Certificate of Exemption is not received before the Show, Entertainments Duty must be paid, as stated above.

"It may be added that, irrespective of any other objection, exemption cannot be granted if the proceedings are to include any extraneous attraction, such as a band, sports, fireworks, &c."

Sugar Beet in England: Prospects for 1921.

HOME Grown Sugar Limited, the Company in which the Ministry holds half the share capital, has now closed its list of contracts with farmers who have agreed to grow sugar beet during the present year. The capacity of the factory is 60,000 tons of beet or 600 tons per day for 100 days, but acting on the advice of their French specialists, the management have limited the tonnage for the first year to 20,000 so as not to overload the factory at a time when the machinery is new, and the English staff to be employed are being trained under the French specialists appointed to supervise each process.

The farmers in Nottinghamshire and Lincolnshire, to whom beet is a new crop, have shown the necessary enterprise, and therefore, it would have been possible to have doubled the acreage actually contracted for; indeed, many such contractors are growing a smaller acreage than they had wished. There are 425 farmers with an average of 5½ acres under cultivation. The 20,000 tons expected from the 2,365 acres contracted for will be despatched from 156 railway and barge stations, and a large tonnage will also be transported by road. For the reasons stated above, only 200 acres are being grown on the Kelham Estate, instead of the 400 originally contemplated. The price is £4 per ton delivered at the factory, which is equivalent to £3 7s. 6d. delivered on rail, and this price was fixed after careful calculation of costs, so as to give an incentive to the grower during the first year to make a speciality of his beet crop, devote his best attention to it, and not limit his expenditure on fertilisers, cultivations and supervision—all of which have a material effect upon sugar content as well as yield.

According to the figures of the test crops on the Kelham Estate last year, the cost per acre of 12 tons delivered on rail was £29 3s. 4d., and the sugar content averaged over 20 per cent. on the crops with a complete manurial dressing.

A silver cup has been offered by the British Sugar Beet Growers' Society, which promoted the present Company and has been assisting in the propaganda among farmers. It is to be competed for each year by growers of 10 acres and upwards, and the competition will be confined this year to growers for the Kelham factory. In this competition sugar content secures the largest number of points.

It now appears certain that in spite of the shortage of

bricklayers and the difficulties of the present abnormal times the factory will be ready by the autumn. The roof is now being put on the main portion of the factory and a large part of the plant has arrived from the machinery contractors, the Compagnie de Fives-Lille, the well-known French sugar engineers. French specialist erectors will supervise the erection by English workmen.

The public should realise that the real commercial test of a new industry is when you have arrived at the point where the raw material is of the best quality, and is being secured from experienced farmers, so that the factory is working with a complete economic supply under the best factory conditions, viz., full time with trained labour. This point cannot be arrived at in the first or second year, but the main essentials have already been secured, namely, a new factory planned on the most modern lines, and a list of growers whose experience in farming under British conditions is of a high order.

The Co-operative Dairy Movement in Working Order.

SUGGESTIONS have been made from time to time to the effect that the Co-operative Cheese Schools started by the Ministry have not proved economically sound, and that the result of their efforts has involved those concerned in loss. This, of course, is very far from being the truth. Of the letters which have been received at the Ministry by those responsible for the working of Co-operative Cheese Factories, one dealing with a considerable undertaking in Denbighshire is typical and may be selected for quotation.

The work of this particular Co-operative Cheese Factory started in 1917 as a Co-operative Cheese School with a loan from the Ministry of utensils and the services of a competent cheese-maker instructor. The local farmers interested in the scheme provided a suitable building and undertook to send in the necessary amount of milk. The school worked for 106 days during the season of milk surplus, and handled upwards of 20,000 gallons of milk, the turnover being rather more than £1,350. The experiment was so successful from every point of view—farmers receiving more money for their milk and a profit on their cheese—that those who had taken part in the first year's endeavour formed themselves into a registered co-operative society with a modest capital of £400. The returns for the years 1918, 1919 and 1920 are now recorded, and the

figures are as follows:—In 1918. 34,000 gallons of milk were dealt with, 16 tons of cheese made and the total turnover £3,100. In 1919, 46,000 gallons of milk received, 21 tons of cheese made, turnover £4,600. In 1920 approximately 60,000 gallons of milk were received and 30 tons of cheese made, with a turnover of £6,000. The cost of production of cheese has worked out at less than 1½d. per gallon of milk dealt with. The Secretary of this thriving factory states that the co-operators are not only perfectly solvent, but that they have put by a good reserve, and find a ready market for their products.

The Society referred to works in a Welsh village 10 miles from the nearest railway station, 500 feet above sea-level, and in the years of its working has produced 80 tons of cheese in a district where none was produced before. The Secretary who supplied figures, which are open to the strictest investigation, has made enquiries at some 30 other centres and finds that his society's effort is not more than an average one. There are others in his district which have done even better, and in the few cases where success has not been achieved, it has been admitted that the management and not the system is at fault. This cheese-making industry is apparently a benefit to the wives and daughters of farmers who live in the wilds. It has saved all the single churnings that were a feature of the life of every farm, and the trouble of marketing the produce, while the consumer is supplied with produce of a uniform standard quality.

Phosphatic Manures: The Present Position.

SINCE the beginning of the year the Agricultural Press has been emphasising two aspects of the supply of phosphatic manures. They are (1) that although official figures show a considerable increase in the production of basic slag it is likely that there will not be sufficient this season to meet the total demands of the farming community; (2) the fact of the production of superphosphate being in excess of the present demand for it may result in large quantities being exported, on account of the congestion at the works. It is natural for the farmer to enquire how these conditions are likely to affect him, and what he should do to meet them.

Three courses present themselves. The first is to discriminate in the use of basic slag. Requirements per acre are greater now than they have been, because the grades of slag quoted

range roughly from 16 to 32 per cent. total phosphates; few range above that figure, and several are below it. When it is remembered that a few years ago high grade slags approximated to 40 per cent. total phosphates, it is obvious that dressings of a 20 per cent. slag must be doubled in quantity to effect the same improvement. Industrial conditions resulting in short time being worked in the steel works may prove a further factor in limiting output. It would seem important, therefore, to confine the use of slag mainly to grassland, and make up the phosphates required elsewhere by dressings of other manures. There are cases where slag appears to confer no benefit on poor pasture, and it seems questionable whether, where that is so, any other form of phosphatic manure would do better. It is worth mentioning, however, that an absolute lack of potash in some soils may prevent any visible result from dressings of phosphates, while on other soils a rough, matted and fibrous covering greatly handicaps the slag in reaching the soil. A very thorough harrowing is imperative to set this condition right.

The second consideration is the possibility of substituting superphosphates for basic slag in order to take advantage of the state of supplies. Local experience or experiment may prompt the use of superphosphates on grassland in place of slag. Approximately 5½ cwt. of 35 per cent. superphosphate equals a dressing of 5 cwt. high-grade basic slag. Generally, superphosphate may be substituted where it has been customary to use slag in cropping; the former is more rapid in action and thus, as a rule, better suited to arable farming. In consequence of this rapidity, its maximum effect is more quickly reached, but where seeds are only down for one year, the influence of this manure applied to the nurse crop will be all that is required. Where there is hesitation to substitute superphosphate for slag altogether, the two may be mixed. Superphosphate will act rapidly on soil with a good lime content.

Thirdly, there is the use of phosphatic manures other than those already discussed. A review of experiments conducted in this country shows that finely ground mineral phosphate is valuable in the north of England and also in Scotland and in Wales. Good results have also attended its use in Essex, and has been applied also with benefit in other districts, notably in those with a high rainfall, and on soils rich in organic matter.

The following is a brief résumé of some of the more important experiments of which records are available:—

Aberdeen 1905–1907, Turnips, Barley, Hay.

In a series of experiments extending over 3 years, the effect of different forms of phosphate, viz., superphosphate, basic slag, bone meal and ground Florida phosphate applied alone and with dung was tested on turnips followed by barley and hay. In the "no dung" plots, both super and slag gave somewhat better returns than mineral phosphate, but when dung was used the mineral phosphate gave the greatest total value of crops and considerably the highest profit.

Experiments in *North Wales* also indicate that rock phosphate is distinctly effective. At six centres the yields of swedes were, on the average of three years 1913-1915, per acre:—

	Tons.	*Cwt.*
No phosphate	13	1
° Basic Slag (482 lb.)	22	4
° Gafsa phosphate (333 lb.)	21	8
° Superphosphate (539 lb.)	22	9

° All contained 200 lb. of phosphate.

These manures are being quoted at a low unit value at present. A mixture of finely-ground soft mineral phosphates and superphosphates may be employed for arable crops. The following quotation from an article by Dr. Russell* summarises the position with regard to mineral phosphates: "*Where basic slag cannot be obtained in sufficient quantity, it is worth while trying mineral phosphates, provided that they are sufficiently finely ground.*" Their cheapness suggests use on rough pasture, especially the poorer, high-lying types rented at a figure which makes dressing with slag out of the question. Bone meal, and especially steamed bone flour, have been showing a cheap unit value of late; both contain a little nitrogen, and may with advantage be mixed with superphosphate.

* * * * * *

Potato Synonyms: Report of the 1920 Committee.

THE whole of the potato industry in this country is affected adversely by the unfortunate habit acquired by certain growers of describing as distinct varieties potatoes that present under careful examination similar conditions of flowering, foliage, growth habit, stem colour, size, shape and colour of tuber, together with identical physiological characteristics. A Committee of the National Institute of Agricultural

* This *Journal*, Jan., 1921, p. 963.

Botany has made investigations on the trial grounds of the Potato Testing Station at Ormskirk in Lancashire, limiting its work to the examination of potatoes not previously tested on the Ormskirk ground for immunity. Four visits were paid—in July, August and October of last year—and 242 varieties of potato alleged to be distinct were tested. Of these, 150 varieties were found to be indistinguishable from one or other of 35 well-known trade varieties; the whole of the 242 were classified in 42 groups. The Committee came to the conclusion that the great majority of synonymous varieties are indistinguishable from popular varieties, and that as soon as a new immune variety appears and achieves popularity, " new " sorts which are new only in name and are indistinguishable from the variety that has achieved popularity spring up at once. As a rule these synonymous varieties of potatoes fall readily into two classes, and the method of classification adopted by the late Mr. Snell, whose great work for the potato industry will never be forgotten, cannot be improved upon. One class comprises those few very familiar types, such as Up-to-Date, Abundance, Great Scot, King Edward and others that are at present in commerce, while the rest are related to half-forgotten varieties, such as Cardinal, Early Rose and Nonsuch class. The best that can be said of the latter is that two established varieties, Edzell Blue and Early Market, may be said to have sprung from it. The Committee does not feel called upon to decide whether these synonymous varieties are actually new growths or whether they are the product of ignorance, carelessness or fraud, but it feels very strongly that the practice of putting synonymous varieties on the market is at once harmful to the good name of the trade and detrimental to the efforts of the National Institute of Agricultural Botany. The carelessness of certain members of the trade is shown in other ways. For example, it is stated that two potatoes quite distinct from each other were introduced by the same firm and under the same name at an interval of rather more than ten years. One was susceptible to Wart Disease; the other immune, and both were indistinguishable from known and established varieties.

It is to be hoped in the interests of the potato industry, which after all is a large and important one, that this report of the Potato Synonym Committee will be widely read and carefully considered. Published at the National Institute of Agricultural Botany at Huntingdon Road, Cambridge, it costs 1s., but applications for copies should be made to the Secretary

at the temporary offices, 10, Whitehall Place, London, S.W.1. The report was submitted in February last to the Potato Industry Conference recently instituted by the National Institute of Agricultural Botany. This Conference represents the Ministry of Agriculture, the Institute of Agricultural Botany, agricultural and trade associations and the leading growers and merchants. All approved the Report and recommended its publication.

Foot-and-Mouth Disease.—*Yorkshire (E. Riding).*—No outbreak has occurred in this district since that confirmed on the 1st March last, referred to in the March issue of the *Journal*, and all restrictions have been withdrawn.

Derbyshire.—The existence of Foot-and-Mouth Disease on premises at Draycott, Derbyshire, was confirmed on Sunday, the 27th March, in four out of nine Irish heifers consigned from County Limerick, which had been landed at Holyhead via Dublin on the 23rd March. Apparently no symptoms of the disease appeared until the 25th March, when the Veterinary Inspector of the Local Authority examined these animals on arrival at Draycott, in accordance with the provisions of the Order of the Ministry under which the animals were landed from Ireland.

In view of the fact that the origin of the disease was definitely established, it was not considered necessary to impose restrictions over an area with the usual 15 miles radius, but to limit the district to one with a radius of about 5 miles around Draycott.

Birkenhead and Holyhead Irish Animals Landing Places.—The existence of Foot-and-Mouth Disease was also confirmed in Irish animals detained at Birkenhead Landing Place on the 29th March, and at Holyhead Landing Place on the 2nd April. These animals were under detention as a result of the existence of disease being confirmed in the Irish animals at Draycott.

The landing of animals in Great Britain from Ireland was entirely prohibited on the 28th March, and special steps were taken to trace all animals which might have been exposed to infection by reason of contact with the animals concerned in these three outbreaks, and at the time of going to press no further outbreak had been confirmed in any part of Great Britain.

Norfolk.—The existence of Foot-and-Mouth Disease was confirmed on the 9th April on premises at North Runcton, Kings Lynn.

Chester.—On the 16th April, the presence of the disease was also confirmed on premises at Bebbington, near Birkenhead.

In the former case, restrictions were imposed over the usual radius of 15 miles from the infected premises, but in the latter, which occurred in the Wirral Peninsula, the estuaries of the Rivers Dee and Mersey afforded effective natural boundaries, and it was not considered necessary to include all the country within the radius of 15 miles which lies beyond these rivers.

Rabies.—*Wiltshire, Dorset and Hampshire.*—Two further outbreaks of Rabies have occurred in this district since the April issue of the *Journal*, viz., on the 23rd March at Southampton and 4th April at Farley-Chamberlayne, near Romsey. No alteration has been necessary in the limits of the existing muzzling area on account of these cases.

Glamorgan and London.—No further cases have occurred in these areas.

Berkshire District.—A further outbreak of Rabies was confirmed (after inoculation experiments) at Stokenchurch, near High Wycombe, Bucks, on the 15th March, in a dog which was destroyed on the 28th January.

Sale of Gooseberries.—The Ministry desires to inform growers of gooseberries, salesmen and others interested in the trade in gooseberries, that all restrictions on the sale of home-grown gooseberries affected with American Gooseberry Mildew have now been removed. The restrictions previously imposed, to the effect that gooseberries affected with this disease might only be sent to Jam Factories, are now revoked, and in future any gooseberries fit for human consumption may be sold freely in any market or shop.

Importation of Gooseberries: Issue of a General Licence.—Under the American Gooseberry Mildew (Importation of Fruit) Order of 1919, gooseberries may only be landed in England and Wales under licence issued by the Ministry. It has been decided that, during 1921 and until further notice, gooseberries may be so landed provided that they are accompanied by a certificate of freedom from American Gooseberry Mildew issued by a duly authorised official of the country of exportation. A General Licence authorising the landing of gooseberries subject to this condition has been issued accordingly.

Importers of gooseberries should, therefore, note that they will no longer be required to obtain individual licences from the Ministry, but that they must make certain when purchasing gooseberries from abroad that the required certificate of freedom from disease has been issued in respect of the fruit purchased. If such certificate does not accompany any consignment, its landing in this country will not be permitted by the Customs Authorities.

Livestock Improvement: The Ministry's Grants in Aid.—It is vital to the welfare of agriculture that the livestock of this country be improved, and steps are being taken by the Ministry to secure this end. The necessity for livestock improvement rests upon three main considerations:—(1) that if the farmer is to pull his weight he must have the best material; (2) the difference on sale value between first class stock and the rest is enormous; and (3) no unthrifty animal can pay its own expenses, to say nothing of those of its master. These arguments are obvious, but there can be no harm in reiterating them in order to bring the question urgently home to all concerned. Deep interest is taken by the Ministry in the whole problem, and it is desired to make improvement practical. Consequently, as part of the Improvement of the Live Stock Scheme which has been in operation for some years, grants are made by the Ministry under certain conditions to:—

(a) Societies maintaining approved Bulls.

(b) Heavy Horse Societies travelling approved Stallions.

(c) Societies or individuals maintaining approved Boars.

(d) Milk Recording Societies.

Full particulars as to the grants made for Bulls, Heavy Horses, Boars, and to Milk Recording Societies can be obtained from the Ministry's Leaflet No. 282.

Tractor Trials, 1921.—The Society of Motor Manufacturers and Traders have arranged to hold their trials this year at Shrawardine, near Shrewsbury, during the week commencing the 19th September. The entries will be classified as follows:— *(1)* Farm tractors for direct traction ploughing and

belt work (internal combustion); (*2*) Farm tractors for direct traction, ploughing and belt work (steam); (*3*) Self-contained motor ploughs and cultivating implements; (*4*) Cable ploughing sets (internal combustion engines); (*5*) Self-propelled garden ploughs and cultivators; (*6*) Tractor ploughs; (*7*) Tractor Cultivators; and (*8*) Disc Harrows. It is to be observed that for the first time in this country separate classes have been allotted to tractors adapted for horticulture work and to tractor implements. It is proposed to have a six hours' continuous ploughing test during the trials, which, unlike those held last year by the Royal Agricultural Society and the Society in conjunction, will be non-competitive.

Export of Live Stock to Uruguay.—As a result of representations made by the Ministry through the Foreign Office, regarding the restrictions on the export of Live Stock from this country to Uruguay, the Government of Uruguay have reduced from 6 to 3 months the period that a county must have been free from Foot-and-Mouth Disease before a certificate for the export of stock from that county to Uruguay can be issued by the Ministry.

Warning to Poultry Keepers.—Recent reports to the Ministry show that deaths have occurred among poultry kept in houses or runs, in the construction of which discarded aeroplane wings or fabric have been used. Owners of the poultry are of opinion that their birds have been poisoned either by picking off the "dope" or dressing from the aeroplane wings or fabric, or by the effect of vapour that is given off at times from the "dope" itself. After careful investigation of certain cases and subsequent enquiry, the Ministry desires to draw the attention of poultry keepers to the undoubted risk of loss that attends the keeping of poultry in houses or runs constructed wholly or in part of aeroplane wings or fabric. It is believed, however, that there is little, if any, risk if these materials are well tarred. Lime must not be used on any account as it would prove destructive to the fabric.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Memoirs of the Geological Survey.—Special Reports on the Mineral Resources of Great Britain. Vol. vii. :—Mineral Oil, Kimmeridge Oil-Shale, Lignites, Jets, Cannel Coals, Natural Gas. England and Wales. (2nd Edition), (125 pp.). London: H.M. Stationery Office, 1920, 5s. net. [55 : 912.]

Memoirs of the Geological Survey.—Special Reports on the Mineral Resources of Great Britain. Vol. xiii. :—Iron Ores (contd.), Pre-Carboniferous and Carboniferous Bedded Ores of England and Wales. (123 pp.) London: H.M. Stationery Office, 1920, 7s. 6d. net. [55 : 912.]

Kent Education Committee; Agricultural Education Sub-Committee.—Notes on Demonstration Allotments and Potato Trials, 1920. (24 pp.) Maidstone, 1920, 6d. [63.512(04); 37(072).]

Collier, D.—Basket-Making. (152 pp.) London: Cassell & Co., 1920, 1s. 6d. net. [63.193.]

Texas Agricultural Experiment Station.—Bull. 223 :—Effects of Lime and Carbonate of Lime on Acid Phosphate. (16 pp.) College Station, 1917. [63.1672.]

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 3.

JUNE, 1921.

NOTES FOR THE MONTH.

Home-Grown Wheat Prices for June, 1921.

In the May issue of this Journal, particulars were given of the arrangements made as regards the price of home-grown wheat of the 1920 crop, and it was stated that for the month of May the average price properly receivable by growers was 92s. per 504 lb.

The Ministry is now informed that the Royal Commission on Wheat Supplies calculate that the cost of wheat imported during March, April and May was equivalent to 86s. 7d. per quarter of 504 lb. for home-grown wheat of sound milling quality. For the month of June, 1921, therefore, the average price properly receivable by growers for home-grown wheat of sound milling quality will be 86s. 7d. per 504 lb.

The Movement towards Live Stock Improvement.

For the present financial year (1921-1922) it has been found possible to allocate a sum of £35,000 for the continuance of the Ministry's scheme for the improvement of live-stock. Of this amount £18,000 is set aside for grants for the provision of high-class pedigree bulls, £7,250 for heavy horses, £3,000 for boars, and £7,800 for milk recording societies. The provision covers grants for 900 bulls, 600 boars, 100 heavy horses and for a few rams which will be used in North Wales, this last being a comparatively new experiment.

The value of the grants is very considerable both directly and indirectly. The direct result of increasing the number of high-class pedigree sires available for the smaller farmer is in itself satisfactory, but the fact that for every sire so located a number of farmers varying from 10 upwards are receiving a practical

(37364) P6/198. 11,250. 5/21. M. & S. A

demonstration of the advantage of good breeding is equally valuable. As a result of the Ministry's Live Stock Scheme many breeders have purchased pedigree cows and heifers to mate with the premium bulls, and not a few members of milk recording societies have become owners of good class bulls of milking strains. The scheme has led also to the establishment of several new herds of pedigree shorthorns in various parts of the country. It is this change in the attitude of formerly indifferent farmers toward the question of good breeding that constitutes one of the most satisfactory features of the progress which the scheme has effected. As an indirect result of the movement towards pedigree which has arisen out of the scheme is the formation of several new breed societies, with consequent improvement both in the quality of the animals and in the prices realised for them. It is significant too that, during the period when the slaughter of calves was at its height, few calves sired by premium bulls went for slaughter. It was clear that those who had bred a good calf were not disposed to see it turned into veal. The mere fact that it had good parentage was sufficient justification for an effort to rear it.

There has been considerable appreciation in the value of the pedigree animals used under the scheme, and in their progeny, and although the sires have in many cases been bought in the first instance at comparatively low figures their value has risen very considerably as soon as their quality is proved. For example, a boar bought for twenty guineas under the Live Stock Improvement Scheme was sold some time later for six hundred, while a premium bull sold for service in a pedigree herd sired nine bull calves which averaged upwards of five hundred guineas apiece. It is reported from one farm that the calves bred from a premium bull made £10 more per head than others bred on the same farm from another sire. In one instance a bull bought under the scheme for £240 was sold for 550 guineas to go abroad, while another that cost 43 guineas under the scheme ultimately reached the Argentine where it fetched 550 guineas. The owner of one of the premium bulls won first prize at the Royal Norfolk Show and has refused £250 for the animal. At the same time it is noticed that service fees are much higher than they were, and are paid without complaint for the use of premium sires.

In addition to the financial assistance afforded to farmers under the Ministry's Live Stock Improvement Scheme the

services of the Ministry's Live Stock Officers are at their disposal, and the advice which is increasingly sought is evidence of the gradual penetration of the scheme into districts where the need for live stock improvement is greatest.

The Progress of Milk Recording.

THE Ministry's Milk Recording Scheme was handicapped in its initial stages by the War, and progress was at first necessarily slow. During the year 1916-17 nearly 13,000 cows were recorded in England and Wales. In the following year the number increased to 20,000, a year later to 38,000, and last year to 60,000. The number at present being recorded is over 85,000, and there will undoubtedly be a still further increase during the present year. In one county the Milk Recording Society has increased from 19 members with 20 herds in 1914 to 83 members with 88 herds at the present time.

The rapid progress now being made is due to the growing appreciation of the advantages to be gained by milk recording. The initial expense and the trouble involved, which made many farmers reluctant to adopt the practice, have been proved by those who were wise enough to give the system a trial, to be well worth while. By keeping milk records the farmer knows just what his cows are yielding, and can ensure that he keeps no cow that does not earn her keep. The variation in the value of the milk produced per cow in different herds is very striking. From figures available for the year 1919-20 it was seen that the average cow in the *best* herd gave £66 worth of milk (valued at 1s. 6d. per gallon). The average cow in the *average* herd yielded £47 worth of milk, and the average cow in the *poorest* herd only £37 worth Figures like these bring home to the farmer the desirability of ascertaining the milking capabilities of his cows, which, moreover, he can have officially certified by the Ministry if his records have been carried out in accordance with the Ministry's regulations.

Certificates of milk yield are issued by the Ministry for milk recorded cows, and give, in addition to the milk yield of the cow, her summarised history for the period covered by the certificates. These certificates have had a remarkable effect on the prices realised at sales of recorded cows. As much as £285 was paid last year for a *non-pedigree* cow with

an officially certified milk record, and it is evidence of the farmers' recognition of the practical value of the certificate that while 640 certificates were applied for in 1916 the number applied for in 1920 was nearly 18,000. It is noteworthy too, that of the cows whose yields were certified by the Ministry last year, 800 gave over 1,000 gallons each and two very exceptional animals 2,000 gallons each.

Although the rate of progress now being made cannot be considered as otherwise than satisfactory, milk recording is by no means as generally adopted as it should be, and in order to encourage the formation of new Societies or the development of existing ones the Ministry makes grants towards the expenses of a Society provided it complies with the Ministry's Regulations. These grants are based on the number of herds in the Society, and amount to £3 10s. per herd per annum for a new member and £3 for a member who has been recording under the Ministry's Scheme for over two years. The total grant payable to a Society may not exceed one-half its expenses for the milk recording year.

* * * * * *

Need for a More General Use of Improved Varieties of Seed.

IN the Agricultural Statistics (Part II) which have recently been issued, attention is drawn to the fact that during the past 35 years no appreciable increase can be traced in the average yield per acre of the principal crops in England and Wales. The returns for individual years are so affected by weather conditions that no conclusions can be drawn by comparing one year with another, but over longer periods unfavourable seasons tend to be balanced by those more blessed by nature, and by comparing the average yield of crops over fairly long periods the influence of the weather can be more or less eliminated.

Taking the average yields over periods of fifteen years, the changes during the past 35 years are small and irregular, and there is practically no indication of any real or substantial change in the average rate of production of the most important crops. In the case of wheat there is some small evidence of a higher yield which may be due to the increased attention which has been given in recent years to improved varieties of seed, though it is not safe to assume that the rather larger yields obtained in the later years are attributable to improved methods of cultivation. The latter, taking the country as a whole, have probably not changed sufficiently to affect the

average production though the more general introduction of heavier cropping varieties must have tended to raise the average yield. It is undoubtedly in this direction that greater returns must be looked for in the future. When it is remembered that many of the newer varieties give yields under favourable conditions of from 40 to 60 bushels per acre, it will be seen that, even allowing for variations in soil, a substantial increase in the average production might be obtained if these varieties were more generally sown. Even an increase in the average yield from 31½ to 33 bushels per acre would mean a total additional production approaching 400,000 quarters, and would often determine the question of profit or loss to the individual farmer.

There has been practically no increase in the average yield of barley, oats, or peas, though in the case of these crops equally with wheat, much higher yields could undoubtedly be obtained by the more general use of improved varieties. In the case of potatoes the average yield during the past 15 years has been about one-fifth of a ton more than in the preceding 20 years. This may conceivably be due to a more general use of seed potatoes grown in another district.

Importation of Cattle: Royal Commission.

IT was announced in the House of Commons on May 2nd that a Royal Commission had been appointed—

"To inquire into the admission into the United Kingdom of live-stock for purposes other than immediate slaughter at the ports, whether such action would increase and cheapen the meat supply of the country, and, if so, to what extent, and whether it is advisable, having regard to the necessity of protecting live-stock bred in the country from the introduction of disease, and of restoring their numbers after the losses to which they were subjected during the War."

The members of the Commission are as follows:—

Lord Finlay (*Chairman*),
Lord Askwith,
Sir Algernon Firth,
Sir Harry Peat, and
Sir Arthur Shipley.

Minimum Prices of Wheat and Oats Harvested in 1921.

THE attention of farmers is again drawn to the fact that in order to obtain the benefit of the guarantee under the Agriculture Act, 1920, in regard to the minimum prices of wheat and oats, a claim must be made in respect of the area on which the wheat or oats are grown in 1921. Forms of claim for 1921 will be issued along with the forms on which the Agricultural Returns have to be made on 4th June, 1921. The claims must be forwarded direct to the Ministry of Agriculture and Fisheries not later than the 30th June, unless the claimant can show that he became the occupier of the land after that date, in which case the Minister may accept a claim made not later than the 1st September, 1921.

The claimant will be required to enter on the form of claim particulars of each separate field of wheat or oats. The number of each field as shown on the 25-inch Ordnance Survey Map, and the ploughed area of wheat or oats in each field, will have to be stated. These detailed particulars are necessary to enable the Ministry and the County Agricultural Committee to verify the accuracy of the claim. Farmers are advised to take steps forthwith to ascertain the numbers as shown on the 25-inch Ordnance Survey Map of the fields sown with wheat or oats.

Copies of the Ordnance Survey Map and the 25-inch scale can be purchased through any bookseller, price 5s. per sheet. In most districts copies of the map of the district can be inspected at the office of the County Agricultural Committee. Information as to the number of fields can also be obtained at the local office of the District Valuer of the Board of Inland Revenue; the Clerk of the Rural District Council and the Assistant Overseer may also possess copies of the Ordnance Survey Maps of their respective districts. In case of difficulty inquiry should be made of the Cultivation Officer of the County Agricultural Committee.

A concise statement of the provisions of the Agriculture Act in regard to these minimum prices will be found in the JOURNAL for April last, p. 8.

Annual Returns of Crops and Live Stock.

THE Ministry desires to remind farmers that the Annual Returns of the acreage under crops, and numbers of live stock will be collected on 4th June. The schedules were issued to occupiers of agricultural holdings at the end of May, and should be completed and returned at

once to the Crop Reporter for the district whose name and address appear on the back of the schedule. The particulars asked for include the acreage of crops and the numbers of live stock and poultry on the holding on 4th June. The numbers of men and women employed on each holding must also be given.

It is of great importance to farmers themselves that the statistical information in regard to the agricultural industry should be as complete and as accurate as practicable, and farmers are urged to endeavour to fill up the schedules correctly after studying the detailed instructions given in the form. The returns should be furnished promptly. A summary of the figures for the whole country will be issued at the beginning of August.

THE NEED FOR LIME AND HOW TO MEET IT.

B. H. BEDELL.

BEFORE the general use of artificials enabled the farmer to forget for a time his ancient friend the lime kiln, he had limed not always wisely but frequently too well, with the result that such stores of lime were laid up in the soil that many fields to-day owe much of their fertility to excessive dressings of lime applied perhaps forty years ago. This happy state of affairs is, however, becoming more and more rare as the years succeed one another and no lime is returned to the soil to replace the inevitable losses. It has been computed that to meet the lime requirements of the arable land only in England and Wales, 3½ million tons of burnt lime would be needed, and that the losses due to all causes on this same land do not fall far short of 800,000 tons a year. As it is improbable that more than 350,000 tons are applied annually it is not difficult to see that we are heading straight for national lime bankruptcy. In fact a time is approaching, and on some farms has already arrived, when no amount of artificial manure can restore loss of fertility due to soil acidity which only lime in some form can correct.

The writer feels, therefore, that no apology is needed for drawing attention to some of the considerations incidental to the production of lime to meet this urgent need.

There are two forms in which lime may be applied to the soil, neglecting unessential modifications. The first of these is burnt lime, and the second is ground limestone (or ground chalk), and each of these can be obtained by the farmer in two ways; he can either buy them, or if his land overlies a chalk or limestone formation, he can produce them himself. At the present time there is a feeling among agriculturists that lime producers are demanding much more profit than they are economically entitled to, or than the increased costs of production warrant. The writer believes that this feeling is by no means always justified by the facts, but where it is well founded, the purchasers (either individually or collectively as a co-operative society) might think well of adopting the second alternative and eliminate the producer's profit altogether by providing their own lime. With this possibility in view, it is proposed to offer a few suggestions as to the plant required and the processes involved, first in the production of ground limestone (or chalk) and secondly in burning these materials to obtain quick lime.

The Stone.—The first consideration is obviously the discovery of a bed or outcrop of limestone of suitable composition upon the estate or near enough to it, to make haulage not too serious an item. All the Upper Chalk is entirely suitable for burning and for grinding; the Lower, or Grey Chalk is by no means so good, and often contains so much combined silica that when burnt it forms a strongly hydraulic lime of doubtful use to the agriculturist. Limestones offer a much wider range of texture and chemical composition than chalk, and before any decision is arrived at with regard to grinding or burning a limestone, samples should be analysed. It may be decided at once that any stone which contains over 92 per cent. of calcium carbonate ($CaCO_3$) is suitable either burnt or ground. Many rocks which fall far short of this percentage of calcium carbonate are also good, but a little consideration of their other constituents is necessary before deciding upon their use.

Magnesian Limestone.—Many deposits of limestone, some of them of considerable extent, and consequently of importance, contain the element Magnesium in varying proportions. Magnesium has a close chemical relationship to calcium, and also occurs in limestone in the form of a carbonate. Magnesium carbonate ($MgCO_3$) is met with in all proportions from mere traces up to 45 per cent., at which point it is in chemically equivalent proportion to the calcium carbonate; such limestones containing a high proportion of magnesium carbonate are termed Dolomites.

There has been much controversy as to whether, to what extent, and in what circumstances dolomitic limestones are injurious to plant growth when applied to soils either before or after burning. Trials have shown that an excess of magnesia in a soil has a toxic action on crops, but the extent of such action depends on the type of soil, the condition of the soil, and particularly on the amount of lime present in the soil with the magnesia. It may, however, be safely assumed that a stone containing up to 10 per cent. of magnesium carbonate can always be used on any soil; higher proportions of magnesium carbonate should be regarded with some suspicion where it is intended to apply the ground stone to land already heavily charged with magnesia.* Ground limestone has been particularly mentioned, for where we are dealing with burnt lime made from dolomitic limestone, we are faced with a new source of danger not connected with any toxic action of the magnesia,

* Further information on the use of Lime or Limestone rich in Magnesia will be found in Leaflet No. 170, p. 13.

but arising from the fact that magnesian lime always takes longer to slake and revert to carbonate than a straight calcium lime, and sometimes takes so long that the soil remains partially sterile for months after it is applied. This "burning" effect is particularly noticeable on light soils.

When therefore dolomitic limestone is under consideration, our conclusions will be very largely dependent upon whether the stone is to be ground or burnt; if the former, we shall probably decide to use it, making a mental note that we would rather it had been straight calcium limestone, but if lime is to be made from it then we shall proceed with the utmost caution, getting a few tons burnt in a clamp or a neighbouring lime kiln as an experiment, and testing the lime before embarking on kiln building and quarry plant.

Before leaving this thorny question of the magnesia content of the stone, there is one other point on which much misunderstanding exists, which it may be useful to discuss. The calcium carbonate content of a Dolomite is frequently spoken of as though that alone could have an agricultural value; this is quite erroneous, for the magnesium carbonate is also capable of neutralising soil acidity, and from this point of view a stone analysing 59 per cent. of calcium carbonate ($CaCO_3$) and 39 per cent. of magnesium carbonate ($MgCO_3$) is not a 59 per cent. limestone but a 98 per cent., neglecting its somewhat slower action, and the possible toxic effect on certain soils.

Another impurity frequently met with in limestone is combined silica, which can have no toxic effect, but in both the ground and the burnt stone it is not only an adulterant but withdraws an equivalent amount of the calcium present from taking an effective part in soil neutralisation. Other impurities likely to be met with are iron, uncombined silica, and organic and earthy matters, none of which need be considered as they are only diluents, and usually occur in quantities too small to be of much importance.

Method of Utilisation.—Having found and analysed the stone we must decide whether it will be better to reduce it to powder in a mill, or to burn it to quick-lime in a kiln. If the limestone contains a high percentage of calcium and the distance over which it will have to be drawn is great, and providing there is an ample supply of coal and wood readily available, then burning the stone is clearly the right thing; on the other hand a Dolomite is usually better applied to the soil as ground stone. Between these extremes there are a great number of intermediate cases which must be decided on their merits.

In comparing the two products it must always be borne in mind that one ton of quick-lime is the equivalent of a little more than 1¾ tons of ground limestone, and that consequently, in cases where a long " draw " is involved, there may be ample compensation for the additional quantity of coal consumed in burning, instead of grinding the stone. This consideration brings us to the question of the relative fuel costs involved in the two cases. To supply the answer in any specific case it would be necessary to know all the conditions, but the following information will be found useful in arriving at a just comparison.

In the average small pot kiln, lime can usually be burnt with an expenditure of from 7 to 10 cwt. of culm per ton of lime produced. In small draw kilns, where the heat losses are considerably lessened by the continuous nature of the process, a fuel consumption of 5 to 7 cwt. of coal per ton of lime may be anticipated, and in large draw kilns as little as 4 cwt. of coal is sometimes used. On the other hand, to grind one ton of chalk or limestone will require about 8-10 horse-power-hours, corresponding to the consumption of 40-50 lb. of coal in an average farm steam engine or of ¾ gallons of paraffin if an oil engine is used to drive the mill.

Although nearly double as much ground stone must be produced in order to be equivalent to the lime, it will be seen that so far as fuel alone is concerned, there is great saving in cost when the stone is ground instead of burnt. If the question is worked out on the present prices of oil and coal the above figures will show that for fuel alone, burnt lime will cost about 16s. a ton, while the equivalent 1¾ tons of ground stone will cost only about 2s. 6d. for power fuel. Running costs and the first capital cost of the installation, however, will generally be slightly in favour of the kiln. The comparative cost of two equivalent plants, one to burn lime and the other to grind stone, both on a very small scale, would be in the ratio of about 1:3—in favour of the kiln. More skill in manipulation and greater previous experience are needed in the case of the kiln than in that of the grinding plant.

Assuming that the choice of process has been made, we will now consider matters connected with limestone grinding plants of small size, such as many farmers could easily instal.

Small Grinding Plants.—The object of all agricultural stone grinding plant is to produce ground stone or chalk in a sufficiently fine state of sub-division to enable it to react readily

with the constituents of the soil and dissolve; hence it is important to know how small the particles of stone must be in order that their function may be fulfilled. If the stone were all reduced to impalpable dust, the object would be attained; this is, however, far from being a practicable proposition, on the ground of both initial and running costs. We have, therefore, to decide, not what is absolutely the best, but what is fine enough to give thoroughly satisfactory results in practice. Not all authorities are agreed on the point of fineness in grinding, but there is a very general belief that a fair mean is struck between the ideal and the commercially practicable, when nearly all the ground stone will pass through a screen having ten meshes to the linear inch, and all the fine material produced in grinding is included. This product contains about 10 to 15 per cent. of stone which is in too coarse a state of sub-division to be immediately useful, but the reason it is recommended is that the type of mill which will produce it is much cheaper, and the power required to drive the mill is so much less than for a similar output of finely ground stone, that there is no doubt about the advantages attaching to the rougher method.

Experiments have been conducted both in this country and in America in order to ascertain what is the actual size of grain below which no appreciable improvement in fertilising value can be detected. Although opinions differ it seems that particles which pass through a 60×60 screen are at any rate fine enough for all practical purposes. It might at first seem that ground stone passing through a 10×10 screen would not be fine enough to be of very much service; such a material, however, would be found in general to contain about 70 per cent. small enough to pass through the 60 × 60 screen. This is a fact not infrequently overlooked by producers of very finely ground but very highly priced agricultural limestone. In the matter of distribution there is an actual advantage attaching to the more coarsely ground product, for it does not tend to clog and hang together like the very fine limestone dust, and for that reason gives much less trouble in the distributor.

The plant necessary to produce this comparatively coarsely ground limestone is so compact and simple that it is possible to mount it in portable form so that it can be drawn by a tractor to any point where it can be fed conveniently with broken stone. A tractor or other portable source of power can be used to drive it. There are many makes of machine, but the Disintegrator is the only type of mill which can be used

to fulfil these conditions. In the case of the small portable machines the stone to be ground is fed into the mouth of the mill in pieces not much larger than 2½-in. cubes; it then passes into a circular chamber in which there are two or more massive, manganese steel hammers, flexibly attached to a rapidly rotating, central shaft. The stone is immediately broken and re-broken by percussion against both the swinging hammers and the walls of the chamber, some part of which, generally the lower half, is composed of stout, manganese steel bars arranged with narrow spaces between them, through which the stone dust can escape when fine enough. After leaving this screen the ground stone falls into a hopper whence it can be shovelled or bagged; it is, however, better to arrange the portable plant so that the stone is fed into the machine almost at ground level, and delivered direct into a cart. This can be readily done by providing a feed elevator to raise the broken stone to the mill, and a second elevator to lift the finished product and shoot it into a cart.

A plant as described above would cost at the present time about £600, mounted on wheels, complete with two elevators. The output would be about 1½ tons of ground stone per hour, and the power taken to drive the mill and its two elevators would not exceed about 15 B.H.P. It is obvious that on small estates where the initial cost of such a plant is more than the needs of one owner warrant, a co-operative scheme should be possible. Success will depend entirely upon careful selection of the plant and attention to certain details, some of which will now be described.

There are many makes of disintegrator on the market, but only a very few are really suitable for limestone grinding. It is important that the swinging hammers should be as massive as possible, and for this reason there cannot be many of them; two are enough, and any number above four is certainly too many. If the machine offered has four hammers, an opposite pair should be dismantled in order to determine whether the mill will not run easier and give the same output as before. Accessibility is an important feature. and the mill chosen must be of a pattern which can be easily opened up for examination of the grinding chamber and tackle provided to take the weight of any heavy parts not swung on a vertical axis.

The screen bars must be easily renewable, preferably in single units, not cast up together in segments; and should be made of manganese steel like the swinging hammers, as no other material is tough and durable enough.

It is a mistake to suppose that the spacing of the screen bars is a measure of the average or largest particles which will come through; the pieces of stone in the disintegration chamber are being driven round with a very high circumferential speed, and only when they are very much smaller than the width of the slots between the bars do they find their way through the screen. For this reason it will seldom be necessary to space the bars nearer than $\frac{1}{4}$ in., and for grinding chalk $\frac{3}{8}$ to $\frac{1}{2}$ in. will be suitable. The harder and more friable limestones will require the closest spacing of screens in order to give a satisfactory proportion of very fine dust.

When the mill has become much worn, care should be taken when renewing old screen bars that no ridge exists between the old and the new ones, since any unevenness in the periphery of the grinding chamber will cause a totally disproportionate quantity of large particles to go through.

The best results are obtained when the mill is run right up to the safe working maximum speed as stated by the manufacturers: loss of speed means not only smaller output, but a less finely ground product.

All varieties of limestone, if freshly quarried, *i.e.*, not much exposed to the weather after being broken, will be dry enough to grind without any preparation. This is, however, far from being the case with chalk. Soft chalk will need to be dried before it is passed through the mill, or it will "pug" and form a paste which will effectively block up the screen and stop the machine.

It is not easy to devise means for artificially drying chalk. Undoubtedly the best course to adopt, where covered storage space is available, is to quarry the chalk and leave it stacked under cover for several months to dry before it is ground. Where there is no such storage space, a drying floor is probably the simplest means, but experience shows that it will take nearly 1 cwt. of coal to dry a ton of chalk sufficiently to enable it to be ground. Some of the harder chalks will give much less trouble than soft chalk, such as that of the North or South Downs.

In any given instance it is easy to ascertain whether the raw material will require to be dried, for if on taking a fair sample and drying it out completely it is found to lose more than 12 to 14 per cent. of its weight, it will not satisfactorily go through one of these small portable mills without being dried beforehand.

THE CONDITION OF PERMANENT MEADOWS.

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Introduction.—In 1920 there were over fourteen million acres in England and Wales under permanent grass, and as much as 30 per cent. of this area was cut for hay.* It is not possible to form a reliable estimate of the proportion of the hay land which is set aside as permanent meadow, but there can be little doubt that most of the hay annually taken from permanent grass is harvested off the same fields year after year. The total area cut for hay from both permanent and temporary grass was over six million acres in 1920, and approximately 78 per cent. of this area was permanent grass. The above figures indicate that on the score of acreage alone meadows are an important feature of our permanent grass lands, but when considering the improvement of grass land attention is usually given chiefly to the betterment of pastures. During the War the writer—when inspecting grassland in a number of counties in England and Wales—formed the opinion that on the average the meadow land was more neglected and relatively less productive in relation to its potential capacity than the pastures. During 1920 opportunities presented themselves for examining the relative condition of pastures and meadows in greater detail in certain Welsh and south-western English counties. The results of this further survey confirm the view that the productivity of our meadows is very far from satisfactory.

The Weedy Condition of Meadows.—It is not only in the matter of yield that there is room for much improvement: perhaps the worst defect of meadow hay is its excessive weediness. If the weed contribution to the Nation's meadow hay could be expressed in tons alongside of the gross produce, it would be an instructive but not a pleasing figure to contemplate. Weeds are unfortunately not only a feature of very poor meadows but are often almost equally abundant on meadows which are regarded as excellent. The number of weed species which contribute in really large amount

* Agricultural Statistics, 1920, Vol. LV (1).

individually (5 to 10 and in some cases over 30 per cent.) to hay crops is comparatively small; the following are probably the worst offenders in this respect:—Sorrel (*Rumex Acetosa*), Yellow Rattle (*Rhinanthus* spp.), Beaked Parsley (*Anthriscus sylvestris*), Hogweed (*Heracleum Sphondylium*), Meadow Sweet (*Spiræa Ulmaria*), Hard Heads (*Centaurea nigra*), Ox Eye Daisy (*Chrysanthemum Leucanthemum*), Dandelion* (*Taraxacum officinale*) and Rib Grass (*Plantago lanceolata*).

Botanical analyses made on meadows in Lancashire which were apparently excellent (in a county which gives the highest average yields per acre from permanent grass†) have shown that the hay consisted in many cases of over 15 per cent. and in some cases up to nearly 30 per cent. of Sorrel. In the same county meadows came under observation where Dandelions were almost the predominant element in the flora. Meadows where this weed, with Rib Grass and Cat's Ear, contribute in abundance to the hay are not uncommon in Montgomeryshire.

Reports on manurial trials afford further evidence as to the weediness of meadow hay. At Garforth, on a meadow yielding above the average (for the country as a whole), the unmanured plot consisted of about 18 per cent. of weeds, chiefly Sorrel.‡ In Gloucestershire, on meadows yielding above the average, the unmanured plots have contained from 2 to 13 per cent. of weeds.§ Comparatively good meadows have been noted in Lancashire and the western counties, containing over 8 per cent. of Beaked Parsley. Yellow Rattle, although most abundant on poor meadows, sometimes contributes over 15 per cent. to the hay on comparatively good fields, whilst the hay from poor meadows in Wales has been analysed and has frequently shown Yellow Rattle to constitute over 30 per cent. of the hay produced.|| The Ox Eye Daisy is abundantly met with both on fairly good and on very poor meadows. At Rothamsted, where the average produce from the unmanured plots is above that of the average of the country as a whole, the weed contribution to the hay on the unmanured plot is about 26 per cent.¶ At Cockle Park, where the average produce from the unmanured plots is below that of the average of the

* Soft Crepis (*Crepis virens*) and Cat's Ear (*Hypochoeris radicata*) are often fairly abundant, the former also being common on leys.

† 34·5 cwt. per acre for 1910–1919, and
36·4 „ „ „ 1903–1912.

‡ The University of Leeds, Agric. Dept., Bulletin No. 113.

§ Royal Agricultural College, *Sci. Bull.* Nos. 4 and 5 for 1912 and 1913.

|| The produce of one meadow consisted of 45 per cent. of Yellow Rattle.

¶ A. D. Hall: An account of the Rothamsted Experiments, 1905.

country as a whole, the weed contribution to the hay on the unmanured plots is about 8 per cent.*

The above brief review has taken no account of Yorkshire Fog and Soft Brome—grasses which should certainly be regarded as weeds on most classes of meadow land. Both are grasses which ripen their seed early; when the hay is cut they are usually over ripe and will have shed most of their seed, and will, therefore, not contribute their full quota to the hay crop, but they will, by their vigorous growth, have hampered the development of other and later maturing grasses. Apart altogether from any question of their nutritive value, therefore, they can hardly be regarded as satisfactory meadow grasses. Both species frequently make an individual contribution of up to and over 50 per cent. to the hay of poor meadows, and contribute largely to that from first rate fields.†

The average weediness of meadows is chiefly due to the following causes:—

1. The complete withholding of manures.
2. Excessive manuring with farmyard manure.
3. Late cutting of hay.
4. Using fields as meadows for excessive periods.

The effect of farmyard manure in comparison with dressings of complete artificials, including sulphate of ammonia, is shown by reference to Table I.

It is apparent that farmyard manure alone and continually applied tends to make for a weedy hay, and that ammonium sulphate included in a complete artificial dressing tends largely to decrease weeds, even in the year of application (see Tarlton, Cricklade and Dry Leaze in the table). Farmyard manure is, however, in many districts practically the only manure applied to permanent meadows, and this largely accounts for the very weedy state of the great proportion of the meadow land in this country. This is well seen in Lancashire, where dung is liberally applied to the meadows which, as before shown, tend to be overrun with Sorrel and Dandelion and also contain an excess of Yorkshire Fog. Improvement in condition would follow if complete artificials were frequently used instead of dung. In many districts good results have followed the alternate use of dung and basic slag.

* County of Northumberland Agricultural Experimental Station, Cockle Park, Bulletin No. 18.

† Meadows in Wales have been analysed, showing Yorkshire Fog contributing 78 per cent. to the hay yield. Soft Brome has contributed 13 per cent. at Garforth (*loc. cit.*). Both are often abundant in the hay from water meadows.

TABLE I.—*Showing the gain (+) or loss (−) in weediness, in comparison with the unmanured plot, of plots manured with dung and with complete artificials, including ammonium sulphate.*

Centre.	*Dung.*	*Complete Artificials with Ammonium Sulphate.*
1. Rothamsted, 1856–1902	—	— 15·1
2. Cirencester,† 1888–1912	+ 2·4	— 2·2
3. Cockle Park,‡ 1897–1911	(1) —2·0 (2) + 13·0	(1) — 6·8 (2) — 3·0
4. Garforth,§ 1899–1919	+ 18·6	— 6·0 ‖
5 Tarlton, 1913	—	— 10·0
6. Cricklade, 1913	—	— 7·0
7. Dry Leaze, 1913	—	— 2·4

1. A D. Hall, *loc. cit.* 2, 5, 6 and 7 Royal Agricultural College, Sci. Bull. Nos. 4 and 5, 1912–13. 3. County of Northumberland Bull. No. 18. 4. Leeds Bull. No. 113.

† Analysis 1912.

‡ Analysis (1) 1905-1906 ; (2) 1907 1908.

§ Analysis 1909.

‖ Sulphate of Ammonia only.

The habitual late cutting of permanent meadows of necessity makes for weediness. The life cycle of coarse-growing plants is not then interfered with. The longer a field is left uncut and ungrazed the more are the perennial non-gramineous elements of the flora favoured, as also are annual weeds like Yellow Rattle, and, indeed, grasses like Yorkshire Fog and Soft Brome which so largely perpetuate themselves by excessive seeding. The rapidity with which meadows deteriorate under the prolonged influence of late cutting is not fully appreciated, the farmer being content to sacrifice the quality of his hay and the condition of his fields for a somewhat problematical increase in bulk.*

Weeds of meadows are in many cases decreased by heavy grazing, and there can be no doubt that much meadow land would, in the last resort, be more productive of human food if used for a number of years as pasture. The conversion of meadows yielding heavy crops of weedy hay into pastures would of course necessitate the production of hay by other means. This aspect of "meadow" improvement is dealt

* In any particular year the greatest bulk is likely to be harvested from late cut hay, but when the effect of progressive deterioration is taken into account it is probable that over a series of years a greater gross produce per decade would be obtained from earlier cutting, and this would certainly be so on poor land. In the writer's opinion the deterioration aspect of late cutting is of greater significance than the loss of nutritive value in any particular season.

with in a subsequent section. Yellow Rattle,* Hard Heads and Sorrel are all weeds that can be decreased, and the two former practically eliminated, by early and prolonged heavy grazing, especially with sheep; under meadow conditions this is not practicable, since the fields have to be put up to hay before the full benefits can be obtained. Yorkshire Fog and Soft Brome are much less abundant under pasture than meadow conditions.

The Average Poor Yield of Meadows.—During the period 1903-1912 the average yield per acre from meadow hay for England and Wales was 23.59 cwt.; for the period 1910-1919 the average yield was 21.70 cwt. The unsatisfactory nature of these figures is clearly shown in Table II, in which the yields obtained from the unmanured plots are compared with those recorded from adequately manured plots at 20 centres.

TABLE II.

Centre.	Hay in Cwt. per acre.	
	Unmanured.	*Manured.*
Rothamsted[1]	23·20	54·10[8]
Cirencester[1]	19·75	35·50[8]
Cockle Park[1]	19·00	30·25[8]
Garforth[1]	24·00	32·25[8]
,,	,,	47·00[2]
Saxmundham[3]	9·50	29·00[8]
8 centres in England and Wales[4]	29·30	38 70[8]
4 ,, ,, Gloucestershire[1]	18·80	30·60[8]
Harper Adams[5]	19·50	32·25[8]
,, ,,	,,	30·75[8]
Scale-Hayne[6]	10·00	18·50[8]
,, ,,	,,	16·00[4]
Herefordshire[7]	27·00	37·50[8]
,,	,,	31·00[4]
Average for the 20 centres	23·00	34·00

[1] *Loc. cit.*
[2] Farmyard Manure only.
[3] East Suffolk County Education Committee, Report, March, 1914.
[4] Dyer, Dr. Bernard and Shrivell, F. W. F., Results of Grass Manuring Experiments, 1910.
[5] Harper Adams Agricultural College, Guide to Experiments, 1914.
[6] Seale-Hayne Agricultural College, Report No. 2, 1913.
[7] Herefordshire County Council, Farmers Bulletin, No. 5, 1920.
[8] Complete Artificials with Nitrogen.

The results indicate that the average produce for the country as a whole comes very close to the average of the unmanured

* Yellow Rattle, as Gilchrist has shown, can be greatly decreased by early cutting, while it can be almost completely eradicated by a number of years' heavy grazing. Experiments at Bangor and at Aberystwyth have shown that dressings of finely powdered agricultural salt applied early in the spring, when the seedlings are just coming up, are able to kill it.

plots at the centres under review, thus suggesting that a large proportion of our meadow lands are left unmanured from year to year. It will also be noted that the increases due to full dressings of artificials or of dung are very substantial. If individual centres are examined it will be found that even fields giving yields well above the average of the country are capable of considerable increases under adequate manuring. Thus Irish experiments show increases of 20 cwt. per acre on fields giving 40 and 42 cwt. from the unmanured plots.* Dyer and Shrivell's figures show an increase of 6 cwt. from 37 cwt.; a field yielding 69 cwt. (unmanured), however, showed slight decreases under all systems of manuring.†

It is not the purpose of this article to discuss the best manurial dressings for meadow hay, but rather to emphasize the need of radically improving our meadow lands, and to indicate some of the methods which are applicable with a view to this end. Nothing is of greater importance than an increased use of manures.‡

Meadow versus Seeds Hay.—It has been suggested that much of our meadow land would benefit by being used as pasture for at least a number of years, but in order to do this it would be necessary to produce more hay by other means. It has been pointed out that seeds hay is only taken from about 28 per cent. of the total area cut for hay, yet seeds hay on the average of the country as a whole yields 6 cwt. per acre more than meadow hay. The relative yields from meadow hay and seeds hay for typical areas are set out in Table III.

It will be noted that in the main those areas where the leys are not typically left down for long show the greatest increase in favour of seeds hay. This is of course to be expected, since the first year's cut of seeds is usually the heaviest. In Central Wales, Derbyshire and Westmorland, where the leys are left down for several years, the seeds hay yields are 5 cwt. better than the meadow hay, despite the fact that the seeds mixtures employed are usually inadequate.

It is interesting to note that Lancashire gives the heaviest

* Department of Agriculture and Technical Instruction for Ireland, Leaflet No. 37.

† Dyer and Shrivell. *loc. cit.* The soil was a somewhat heavy loam and the field was an old pasture.

‡ For particulars as to the best means of manuring meadow hay the reader should refer to the publications already cited, to one of the Ministry's Miscellaneous Publications, No. 24, *The Improvement of Grassland*, and to an article on the Increased Production of Grass by Gervaise Turnbull, Vol. XXVI (p. 607) of this *Journal*.

TABLE III.—*The average yields from meadow hay and seeds hay compared. The figures are based on the average of the statistics for the periods* 1903-1912 *and* 1910-1919.*

Areas.	*Increase, in cwt. per acre, of Seeds Hay over Meadow Hay.*
England and Wales	6·0
Cambridge, Essex and Norfolk	7·2
Lancashire	8·9
Cardiganshire, Radnor and Brecon	5·2
Derby and Westmorland	5·1

average yields of meadow and seeds hay, and that Westmorland also takes a high place in respect of both, although the leys are frequently left down for two, three or more years.†

In respect of yield, therefore, average figures are markedly in favour of seeds hay. There are unfortunately not many exact experimental data available contrasting the yields from well managed leys and from permanent meadows on similar soils. The following trials, however, afford further evidence.

Seale-Hayne Agricultural College (*loc. cit.*).—Mixtures for 3 or more years were put down in 1910; the average yield‡ of hay per acre per annum for the first two years was over 36 cwt. for the five plots sown, the highest per annum average being 41.75 cwt. The yield in the first year was nearly 12 cwt. greater than in the second. Another series of plots gave from 42 to 47 cwt. of hay in the first year.

Manurial experiments on permanent grass did not give a higher yield than 25 cwt. The soil was apparently, however, decidedly poorer on this latter field, so that the comparison is unfortunately not a fair one.

Cockle Park.—Gilchrist§ has conducted exhaustive trials on seeds mixtures at Cockle Park; well balanced mixtures, including Cocksfoot (6 to 12 lb.) and Wild White Clover, have been employed on poor and stiff clay soils. The best mixture under the best manurial treatment has averaged a yield of

* Agricultural Statistics, Vols. XLVIII (Part II) and LV (Part II).

† It is somewhat remarkable that Leicestershire and Northamptonshire, famous for their pastures, take a low position in respect of both meadow and seeds hay; the best fields, however, are not brought under the plough, and probably only the poorer grass fields are put up to hay.

‡ The second year yield from the Elliot Mixture (with 8 lb. Cocksfoot) came within 8 cwt. of the average of all the first year yields.

§ Gilchrist, Prof. Douglas A., Northumberland County Agricultural Experiment Station, Cockle Park, Bulletin No. 31, 1920.

33 cwt. per acre per annum for 12 years. Averages of 46 cwt. per acre per annum have been obtained, for three-year periods.

Permanent meadow land under dung and artificials has averaged 41 cwt. per annum for 23 years; under artificials alone 30 cwt.

Saxmundham.—Mixtures have been down for 8 years. The best mixture under the best manurial treatment has given an average yield of 29 cwt. per acre per annum over the period, which is precisely the same yield as that averaged on permanent meadow under the most productive manurial treatment for a period of 12 years.*

West Aberdeenshire.—Five plots sown in 1911 gave an average yield of 43 to 49 cwt. per acre per annum for a three-year period. The yields in the first year ranged from 66 to 75 cwt., in the second from 33 to 37 cwt., and in the third from 29 to 40 cwt.†

Central Wales.—Hay yields in the first year varying from 40 to 60 cwt. per acre have been obtained. An extensive series of trials was started in 1912, but owing to the War it was impossible to obtain results after the first year.

The above figures show that under proper manurial treatment heavy crops may be obtained from seeds hay for a number of years. The first crop is usually the heaviest and may be more bulky than that obtained from even the best meadows highly manured. High average results may be harvested for three or four years—results as good, and in some cases slightly better than those obtained from well manured permanent meadows on similar soils. The Saxmundham trials have shown that mixtures of the Elliot type are less dependent on manuring than are more ordinary mixtures or than permanent meadows.

The foregoing review has only taken account of bulk. It is, however, on the score of freedom from weeds, including Yorkshire Fog, Bent and Soft Brome, that well managed seeds hay is so much superior to even well manured meadow hay. The worst weeds of meadow hay do not make an early appearance on leys, whilst by resort to a well balanced mixture of highly pure seeds (including a sufficiency of Cocksfoot), Soft Brome and Yorkshire Fog can be successfully suppressed for at least three to six years. The inclusion of wild white clover makes for a clean sward which, under good manage-

* *Loc. cit.*

† North of Scotland Coll. of Agric., Experiments, Leaflet No. 46.

ment, may be maintained in a high state of productivity for at least a decade.

Botanical analyses of the seeds hay are not available for the centres referred to; the writer, however, made rough estimates on the plots at Seale-Hayne and at Saxmundham in 1917.*

At Seale-Hayne, Elliot mixtures then 5 and 7 years down were remarkably free from weeds. At Saxmundham the degree of weediness of the plots expressed on a scale of marks was as follows:—

Permanent meadow, unmanured	180
,, ,, slagged	120
Elliot Mixture	25
All other mixtures (average)	90

Numerous analyses on leys of various ages have been made in Central Wales. When good seeds mixtures have been used the swards have been free from weeds for several years, but Yorkshire Fog generally begins to be abundant after the fifth year. This grass always tends to become abundant on fields continually cut; thus at Saxmundham it was almost equally abundant on the permanent meadow plots and on the ley plots eight years down, whilst on the Cockle Park meadow hay plots this grass has increased on even the "artificial" plots, and particularly on the dunged plots during 9 years.†

Having regard both to freedom from weeds and from Yorkshire Fog and also to the production of maximum bulk, it appears therefore that the four- to five-year ley has much to recommend it as a means of increasing the hay supplies of a farm. Meadow hay has of course a special value, since it is a safe feed, but the hay of a good ley in its third to fifth year, when the Red and Alsike Clovers will have more or less completely disappeared, is not very different from meadow hay, except that it is likely to be far less weedy!

There are many farms in Wales and the West of England where good fields—fields with a high potential grazing value—have been ruined by continual mowing: these fields should be heavily slagged and heavily grazed. An extension of the temporary ley on the more ploughable part of the farms would at once have the effect of (1) providing the necessary amount of hay, and (2) what from the Nation's point of view is so much to be desired, namely, keeping land under cultivation.

* The estimates were made in connection with an inquiry conducted for the Food Production Department. Thanks are due to Mr. B. N. Wale and to Mr. A. W. Oldershaw for information and assistance.

† Northumberland County Agricultural Experiment Station, Bulletin No. 8.

SIMPLE COST ACCOUNTS FOR FARMERS.

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AT the present time farmers may find it advisable to pay Income Tax upon profits under Schedule D rather than under Schedule B, in which case it is necessary that they should adopt some system of account keeping. It is possible indeed that Schedule B may be withdrawn. The most desirable system of book-keeping is one based upon " costs." Not only does it obviate the danger of the farmer being called upon to pay tax upon profits he has not realised, but it can be made of great help in the conduct of his business because it makes clear what the various parts of the business are contributing to the final result. It is often objected that farming must be looked at as a whole, that the flock and the bullock feeding are so bound up with the corn growing that one can neither say how much one makes in comparison with the other, nor change the way of farming to correspond with the estimated profits or losses. No great difficulty will, however, be found in separating the costs of the main items of the business of a particular farm, like the corn growing, the milch cows, the flock, &c., and the farmer who is persistently confronted by a loss in one department will not be long before he finds a more profitable way of conducting that part of his business and exchanging it for some other. The great point of cost accounting is the power of control which the farmer obtains by thus seeing how the various items which go to make up the business of a farm are each of them answering.

Again, a cost account gives a much sounder statement of the results of the year's working. Under the ordinary system of book-keeping a valuation has to be made at the beginning and end of the year, and these valuations are combined with receipts and expenditure to make up the profit and loss account. The valuations introduce two sources of error. The quantities of produce like corn may be incorrectly estimated and the values attached may never be realised. Again, the valuation confuses stocks which are only used as " plant " and are not meant for sale with the produce of that plant. For example, between Michaelmas, 1919, and Michaelmas, 1920, the valuation of the ewes in a breeding flock had appreciated by something like £3 a head. Unless the farmer is meaning then and there to dispose

of his flock that appreciation is not realisable and should not be treated as a profit, as it would be under the ordinary system. On the valuation plan the farmer shows profits (or losses) that have not been realised and may have to pay tax upon them; on the costs basis as little as possible beyond cash realised comes into the final account—there is no anticipation of profit. Of course there is equally a valuation at the beginning and close of the year, but it is really in the nature of a stock taking, in which the stock is valued at its cost.

The chief objection of the adoption of a system of cost accounts is the amount of book-keeping involved, requiring more time than can be given to it by the ordinary farmer, who rightly enough considers that he will get most value for his effort if it is spent out of doors seeing that the work is kept up to the mark. A farm of under 500 acres will hardly pay for a book-keeper unless it is intensively cultivated. But on the smaller farms the labour of cost accounting can be greatly reduced and brought within the compass of a master who can only give a few hours a week to it, even if he can get no assistance. What is necessary is to abandon the effort to obtain the cost of production of individual crops and to adopt a few arbitrary rules for the valuation of young live stock. If one is to obtain separately the costs of growing wheat and of growing oats it is necessary to open an account for each field and to allocate week by week the labour, manual and horse, spent on each field. This means not only a good deal of labour in making up the time sheets day by day but a lot of actual desk work in transferring the particulars to the books.

In the end little is gained by ascertaining how much more profitable Field A is as compared with Field B. or that wheat, for example, pays better than oats. Both have to be grown for reasons dictated by the rotation, and in so far as the farmer can shift a little from one to the other ordinary considerations of yield and price give him sufficient guidance. The more important question is what the arable land as a whole is yielding as compared with grass, and whether the crops or the stock are bringing in the money. Of course a special account can always be opened for some particular crop about which the farmer wants information; for example, he may be a considerable potato grower or may wish to know whether that crop is worth developing, in which case he must go to the extra trouble of finding the cost of the labour, manures, &c., spent on the potato acreage as distinct from the rest of the arable land.

While the complete system of costing is very desirable the

purposes of the majority of farmers will be met if the farm is divided into a few main departments, for each of which the books will provide a closing account and a profit and loss statement. These closing accounts would vary with the farming but would be in the majority of cases selected from the following: Arable land crops, with, in some cases, Potatoes as a sub-head; Old land for hay; Milch cows; Bullock fattening; Breeding or Flying flock; and Pigs.

Cost book-keeping begins essentially with an allocation of horses and manual labour to the separate departments for which a closing or working account is kept. This can be considerably simplified by marking off some of the men once and for all; for example, the horse-keepers or carters can be charged straightway to the horse working account, the shepherd to the flock account. One man may be attending to both cows and pigs; his annual kept and the times entered up weekly to the various accounts. But for the labourers and for the horses a time sheet must be kept and the times entered up weekly to the various accounts. One need not attempt to work on a smaller unit than a half-day. This then is the chief trouble, the maintenance of a weekly time sheet allocating labourers and horses to crops, hay land, grazing land, flock, cows and pigs, and to some general account for odd jobs like repairs, fences, &c., which cannot well be assigned to any particular working account.

The Initial Valuation.—The first step to take consists in fixing the date at which the working year begins, Michaelmas or Lady Day, and making the initial valuation, which cannot be on a strictly cost basis.

As regards the *dead stock* the best plan is to enter every article up in a Stock Book and set against it its present value, the amount of depreciation to be taken off each year, and a final value below which it will not be written down as long as it remains in commission. The amount to be written off each year will be an arbitrary figure determined by the probable life of the article. For example, it will be wise to write 25 or 30 per cent. off the value of a tractor every year, while 7½ per cent. would be enough to write off a plough. A fresh column is taken for each year and in it is entered the depreciated value of each article or a blank if it has been broken or sold, so that the total of the column gives the amount to be entered in the valuation, while the difference between the total and the total of the previous year gives the amount that is to be charged out as depreciation. The implements may be grouped according to the different closing

accounts which are to be debited with the depreciation on their group, or the total depreciation may be divided in proportion to the respective labour bills.

Horses may be treated in the same way; a value is attached to each with an annual depreciation of £6 or £7 a head to be charged to the horse working account. In the case of young horses the depreciation may be exchanged for an appreciation up to the age of seven but little is to be gained by so doing, since the horses are not intended to be sold.

For the *milking herd* a standard value should be adopted for all the cows in milk; this value is to be retained in all subsequent valuations and multiplied merely by the number in order to obtain the valuation. If the farmer rears his own heifers, heifers and calves of all ages up to the time they begin to milk are valued at half the standard value of the cows.

For *store stock* other than heifers an initial valuation of 10 per cent. or so below the estimated market price may be made.

For the *breeding flock* a similar method is to be adopted. A standard value is taken for a ewe, another for any rams, and their values are kept unchanged from year to year, so that the total valuation only varies with the numbers. A similar standard value is placed on all lambs and tegs; this may be half the ewe value in a Michaelmas valuation for a flock lambing about Easter, and three-quarters of the ewe value for such lambs as remain unsold at Michaelmas from an early lambing flock. In the case of a Lady Day valuation only the ewes are reckoned.

In the case of a *flying flock*, the cost price, if a recent purchase, or a market valuation less 10 per cent., may be adopted for the initial valuation.

For the *pigs* the same principle may be adopted. The breeding sows and the boar have standard valuations attached to them, not varying from year to year, and a market valuation less 10 per cent. is put on the store pigs.

The *tillages* are valued at their estimated cost. It is simplest to ignore unexhausted residues of foods or manures, as they only become a realisable asset when the occupier leaves the farm and the variation from year to year will not be great. For the purposes of the balance sheet a fixed value may be adopted and carried forward from year to year.

Similarly the *farmyard manure* may be valued at a fixed price.

The *crops* must be valued, not only the corn, but the roots and the green crops. For the feeding crops it is necessary to adopt a series of arbitrary standard values, which properly

should be the cost of growing less allowances for the cleaning and manure by which succeeding crops benefit. As these cannot easily be worked out by the farmer, the following arbitrary figures may be adopted :—

Mangolds, Swedes and Turnips, to be carted off, £15 per acre.
Swedes and Turnips to be fed off, £10 per acre.
Vetches, Kale, Rape, &c., to be fed off, £8 per acre.
Feeding Stuffs, Manures and other stores in stock may be taken in at cost.

Working Accounts.—Having prepared a valuation, a series of working accounts must be kept in ledger fashion, and it is necessary to determine how many of these accounts shall be opened. The following will prove to be sufficient for most farms :—

Manual labour.	Farmyard manure.
Horse labour.	Milch cows.
Grazing.	Store cattle.
Meadow hay.	Breeding flock.
Crops (3 accounts).	Flying flock.
Feeding stuffs.	Pigs.
Artificial manures.	Establishment, and
Implements.	Cash.

Taking these accounts one by one they will be treated as follows :—

(1) *Manual Labour.*—All the wages go into this account as debits. As credits the wages of the horse keepers are transferred quarterly to the horse working account, of the shepherd to the flock account, of the stockman to cattle and pigs, as previously explained. As regards the labourers, on the credit side a record is transferred week by week from the time sheets of the days spent on the various departments of the farm, and quarterly the cost of the labourers is divided in proportion to the days and assigned to the respective accounts.

(2) *Horse Labour.*—This account is debited with the depreciation on the horse stock, with the labour of the horse keepers, with the oats and other feeding stuffs, and with an item for grazing. On the credit side are recorded the number of days worked for the different departments. The total cost of the horses is divided by the number of days so as to obtain the cost per day, and the various departments are debited with this cost per day multiplied by the number of days work they have had, so that the account is cleared like the manual labour account. The cost of the horse day is an important figure for comparison from year to year. It should also be calculated

after excluding the wages of the horse keepers so as to show the cost per diem of the horse alone.

(3) *Grazing Account.*—This should be charged with the rent of the permanent pasture land and with one-third of the rent of the meadows laid up for hay and only grazed as aftermath. It is also charged with labour, manure applied to pasture, any cake or corn fed on the pastures, and with a proportion of the depreciation of implements and establishment expenses. On the credit side a record is kept of the number of days grazing, reckoning a cow or bull equal to five sheep, heifers and young cattle equal to three sheep, horses turned out for the night equal to two sheep, horses wholly out to grass equal to five sheep. The total number of sheep days grazing thus obtained is at the end of the year divided into the gross expenditure so as to obtain the cost of one day's grazing, and the account is then cleared by charging each of the livestock departments with the number of days' grazing it has had.

(4) *Meadow Hay.*—This account is charged with the rent of the fields laid up for hay, with the manure applied and the labour spent on the fields and during hay making, also with a share of the depreciation and establishment expenses. On the credit side one-third of the rent and of the manure is debited to grazing as representing the after-math. The quantity of hay produced is estimated and charged to the feeding stuffs account at 10 per cent. less than market price. The balance of this account goes to profit and loss.

(5) *Crops.*—As most of the crops are unrealised at Michaelmas it is necessary to open separate accounts (a) for the unrealised crops, (b) for the crops that are being grown during the year, and (c) for any tillages that may be made before Michaelmas for the succeeding year's crops.

The first account will be debited in the first instance with the valuation of the crops at Michaelmas, or in succeeding years with their costs. It will be further debited with any additional work spent on these crops, as, for example, thrashing and delivery. The credits will be the corn sold and the roots and other green crops at standard values as indicated above, these being debited to the appropriate livestock departments. The balance goes to profit and loss.

The second account for the year is debited with the tillages in the valuation, with manures, seed, horse and manual labour, and a share of establishment expenses and of depreciation on the implements. On the credit side comes the seeds

hay sold to feeding stuffs at market price less 10 per cent., the green crops consumed during the year at the standard values, and the grazing of the seeds, to which a similar standard value must be attached. The balance at Michaelmas is transferred to the valuation, and becomes the debit with which the (a) account starts in the following year.

The third account, which is only opened towards the close of the year, contains horse and manual labour, manure, &c., for the crops of the succeeding year, and is also transferred to the valuation, whence in the following year it is transferred to the (b) account.

(6) *Feeding Stuffs Account.*—This is only made up for convenience. It is debited with the stocks and the feeding stuffs bought and the hay from both the seeds and the meadows. It is credited with the amounts transferred to the various livestock departments and any stocks in hand at Michaelmas.

If considerable quantities of artificial manures are bought it is convenient to have a similar account for them. Again, an account must be opened for the depreciation of the implements as ascertained from the Stock Book, to which must also be added expenditure on repairs, to be balanced by credits from the accounts among which the whole costs are to be divided.

(7) *Farmyard Manure.*—This is debited with the straw and the manurial value of the foods fed to the cattle or pigs in yards, also with the labour spent on clearing the yard and making mixens. An estimate may be made of the quantity of manure when carted out on to the land so as to obtain a figure of the cost of a load of farmyard manure for comparison from year to year. When aiming at simplification this account may be dispensed with altogether, in which case no credit is given to the crops for the straw that is used upon the farm or for the manure value of the foods, while the labour spent on the manure is charged straight away to the crop account.

(8) *Milch Cows.*—The debit starts with the valuation: cows and bulls at their standard values, the heifer calves at their standard values. Any additions to the herd that are purchased are debited at cost but depreciated year by year at a certain rate to bring them down to the standard value. Further debits are the feeding stuffs consumed, grazing, horse and manual labour, and a share of the depreciation and establishment expenses. The credits are the sales of milk, of calves, of cast cows. If an account is opened for farmyard manure the manure values of the foods consumed are credited to this

account and debited to farmyard manure. The balance goes to profit and loss.

(9) *Store Stock.*—Any stores on the farm at the beginning of the year are debited at the valuation, other stores purchased at their cost price. The further debits are the feeding stuffs they consume, including crops, the horse and manual labour attributable to the stock, and the share of establishment expenses. The credits are the sales, and the manure value of the foods if a farmyard manure account is opened. If at the end of the year there are still some stock unsold the total of the debits should be divided by the number of stock either sold or still on hand, and those remaining on hand valued forward to the next year at the average cost per head. There will be a balance on this account to be carried to profit and loss.

(10) *Breeding Flock.*—The debit begins with the valuation, the ewes and rams at their standard price per head, and the lambs at their standard price. The other debits will be ewes purchased and rams hired or purchased, the crops and feeding stuffs consumed by the flock, the horse and manual labour, and the depreciation and establishment expenses. The credits are the sales of the lambs and tegs, cast ewes and wool, together with the closing valuation made by numbers at the standard values. The manure value of the foods consumed should be also credited to this account and charged to crops.

(11) *Flying Flock.*—This is treated exactly like the store stock account. The debits are the initial valuation or the purchase price, the crops and feeding stuffs consumed, the labour and the establishment charges. The credits are the sales and the valuation of whatever may remain unsold at cost, the cost being divided as before according to the numbers sold or unsold.

(12) *Pigs.*—The debits begin with the valuation of the stock sows and boars at standard values, together with the store pigs at their standard values. Other debits are the feeding stuffs, labour and establishment charges. On the credit side come the sales and the valuation of the store pigs unsold. This valuation is again made by their numbers multiplied by the ascertained average value of keeping a store pig for the part of the year it is on the farm, *i.e.*, the total costs divided by the number sold during the year and on hand at the closing date.

(13) *Establishment.*—This account is debited with the labour spent upon such operations as cleaning ditches, fences, road mending and other repairs, together with sundry items like travelling expenses, stationery and postages, which cannot

be specifically allocated. At the end of the year the total should be divided up among the various closing accounts on some conventional basis, such as the relative expenditure on labour in each department or in proportion to the turnover.

(14) One more account is necessary into which are brought the bills owing or unpaid, the cash in hand and at the bank, and the capital.

It is difficult to make clear in the brief space available a system of book-keeping, and many readers may be led to feel that the method proposed is far too complicated for them to take up. Actually, as soon as the principle has been grasped and the farmer has got over the first difficulty of starting, the system will be found to work with surprising ease. Mr. C. S. Orwin, the Director of the Institute for Research in Agricultural Economics at Oxford, will be glad to assist any farmer who wishes to start book-keeping on these lines.

THE CONTROL OF FARM MANAGEMENT AND SOME FUNDAMENTAL PRINCIPLES IN AGRICULTURAL COSTING.

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THE importance of the study of Farm Management is receiving recognition only slowly. The expansion in agricultural education and research work which began about five and twenty years ago has been confined almost entirely to natural science, and although results of enormous practical value to the farmer have been produced, the full benefit of such work has not been secured owing to the neglect of any attempt to balance it by the study of agricultural economics. The economic law with which production from the land has to contend is the law of diminishing returns, while any attempt to wring the last bushel of corn from the land and to produce the last pound of meat and the last gallon of milk can only be justified so long as it can be shown that maximum production is accompanied by maximum financial reward. It is always the economic factor that, in the long run, controls production. Soil and climate are factors of obvious importance, but innumerable examples can be given of the adaptation of poor soils to most intensive husbandry, given suitable conditions as to supplies of fertilisers and accessibility of markets, whilst far better soils under less favourable economic conditions are perforce devoted to far less productive systems of management. The successful farmer is not necessarily the man who produces that which soil or climate or inclination indicate, but he who, after a study of economic factors, decides which will be most profitable. Such a study depends largely upon his ability to examine, by scientific book-keeping, the processes of production.

Costing, or management book-keeping, aims at much more than mere financial accounting. The latter is intended to furnish evidence as to the general financial position of a business at any time: the former supplies the only means by which the management of an enterprise can be tested and examined in all its departments. When industry was in a primitive condition—when people were producing mainly to satisfy their own individual needs—there was no necessity for an analysis of the costs of the various processes of production, but in proportion as the

producer worked to supply not only his own wants but also those of the open market, in which he had to compete with other producers, so the need for controlling production increased. Every enterprise working to supply a market has two sides—the technical side involving technical skill in the various processes, and the managerial side, which controls the technical skill so that effort may be applied economically and the final product-cost reduced as low as possible. As a business grows so does the tendency to separate the functions of the technical and the managerial staff increase, until in the great industrial organisations of to-day we find a fairly complete division between them. This has given opportunities for individuals who, knowing little or nothing of the technical side of a business, are yet able to control it successfully by a system of management based on records of cost in every process. "A man who is 100 per cent. efficient as the manager of one particular business will prove to be 90 per cent. efficient as the manager of any business" is the dictum of a certain successful manufacturer, who thus appears to value technical knowledge in a manager at no more than 10 per cent. of his total equipment, and it is certainly true that most large industrial enterprises of our day are controlled by men who are experts in management and in analysing the processes of production rather than in technique.

In agriculture, such specialisation has not gone so far, except in a few cases. Men of proved ability in industrial organisation not infrequently turn their attention to farming, but do so generally as a relaxation or for social considerations rather than as a business proposition. There are, however, conspicuous cases of men who, knowing nothing whatever of farming, have made a great success of it, and it may be surmised that the direction of any large agricultural venture would be better in the hands of the man who had proved himself competent to run a big productive organisation of any kind than in the hands of one who had merely shown good technical ability in running a small farm. Although large-scale production in agriculture is rare, and the manager and the technical expert usually "wear the same hat," this detracts in nowise from the importance of management and the means of directing it, and probably the greatest weakness in the agricultural industry to-day is the reliance of the farmer on his technical knowledge to the more or less complete exclusion of the study of management. The farmer must come to recognise that his skill as a practical man requires direction, and that he can never be sure that he is making the best use of the factors

of production without the means of examining and testing the application of his technical ability.

The basis for any system of management book-keeping for the farm is the *Valuation*, and more errors in costing spring from false principles in this matter than from any other cause. In industrial undertakings the position has been established firmly and clearly enough. With rare exceptions the principle is to value plant at cost, less depreciation; to value goods in the process of manufacture at cost; and to value manufactured stock at cost, or at cost or market-value, whichever be the lower. In agriculture the position is equally clear and definite, and it is the almost universal practice to value practically everything at market price. The explanation of this difference in practice is that in farming there is not the sharp line of demarcation between plant and product that exists in other forms of industry. A ewe may be regarded as a machine for the manufacture of meat and wool, but it is a machine which, in due course and before very long, itself goes to market as a commodity. Indeed, the amount of working capital invested in the farm in plant and equipment of a permanent or semi-permanent nature bears a very small proportion to the total capital, and the fact that the bulk of the "machinery" for production will itself be placed on the market, combined with the fact that costs of products in the process of manufacture are never available, has led to this difference of principle in making valuations on the farm as contrasted with the other forms of industry. It must be remembered, however, that although the ewe and the cow fulfil their purposes of manufacturing animal products for the market for a short time only, and are then themselves marketed, the flock and the herd remain, and it is these rather than their individual members which must be regarded as constituting the producing plant, and their valuation should remain at a figure constant from year to year, except in so far as this sum is affected by changes in the total numbers of the flock or herd for the year. Regarded in this way there is no longer the difference between the productive machines of the factory and those of the farm, and the valuation of the latter can and should be made on the same basis as that of the former. Thus, the valuation of flocks and herds is a matter of numbers only, the value per head, based on the cost or estimated cost of the animals, being kept at a constant figure from year to year. Depreciation, which is necessarily deducted in the case of dead stock used in the processes of production, does not enter into the annual valuation of live stock,

as the state of the flock or herd is maintained at a constant level by the sale of old animals and the introduction of young ones.

The valuation of stock on a market value basis robs the accounts of their whole use as a guide to management. The final product-cost will include a concealed profit or loss. For temporary causes, such as a shortage of keep at home or the closing of foreign ports to imported live stock, may turn a profitable year into one, apparently, of serious loss if market values are assigned annually to breeding stock not intended for immediate sale. Similarly, a temporary inflation of values for any cause would lead to unwarranted optimism as regards the year's results in the particular department concerned. Many men to-day are farming with the same stud of horses they had seven years ago. They have seen the average market value rise, in many cases by some 200 per cent., and fall again nearly to the original value. An annual valuation based on the market value of the day could have caused nothing but confusion, as introducing paper profits first and then paper losses, neither of which would have had any actuality.

In valuing crops the same cost principle must be adopted. There is no need to speculate as to the probable yield of a field of roots or a stack of corn and then apply some market price to the result which, in the former case, can have no possible reality, and in the latter case may be entirely falsified by the turn of events before the corn can be marketed. The cost of the crop up to the date of valuation compared with the market price subsequently realised enables the farmer to assess the results of his management in this department. If the crop be fed to stock on the farm instead of being marketed direct, the financial result is obtained when the stock is sold, and the farmer is in a position to contrast the results of direct and indirect marketing, together with such questions as crop substitution and so forth. If once the actual facts of the farmer's own experience as revealed in his books are allowed to give place to values assigned by others, all basis for comparison is lost.

Having settled the basis on which to make the valuation, other questions arise in agricultural costing for the treatment of which definite principles must be laid down if the results are to have any real value as a guide to management. One of these is how to deal with *Rent* In the sense in which the term is used by economists, rent is not an element of cost, for it represents nothing more than the value of production due to variations in situation and the inherent capabilities of the soil. "Rent is due

to differences in the productivity of different pieces of land, the users of which are working for the same market, differences over which the owners have no control. From this the corollary is drawn that rent does not enter into the cost of production. Corn, in Ricardo's words, is not high because a rent is paid but. a rent is paid because corn is high."* This theory of rent is interesting as an economic conception which, in certain special cases, may even have a practical application, but to the English farmer in most places it is merely an abstraction, and to give the term the peculiar limitations assigned to it by economists, and then to say that rent does not enter into cost of production, is to create a set of conditions having no existence in fact on most of the farms of this country. The rent paid by the farmer has little or nothing to do with the inherent capabilities of the soil, except in particular cases which do not bulk large in the agriculture of the country as a whole, for it represents nothing more than a certain return to the originator of the enterprise, or his successors, on the cost incurred in bringing virgin soil into the condition precedent to the production of food and other agricultural produce.

Rent is the interest which the capitalist expects to get as an inducement to him to invest money in draining, enclosing, road making, erection of houses and buildings, and in other works of reclamation and equipment necessary to turn virgin soil into farm lands. It is true that farms created at equal unit cost in the past may let to-day at different unit rentals, but this is not to say that those commanding higher annual values include in this value an element of rent as defined by economists; rather does it mean that those letting at the lower figures are giving to the capitalist a lesser reward for his enterprise.

It follows that rent paid by the farmer, except in particular and relatively unimportant cases, is an element in the cost of production and must be included in cost determinations. There seems to be no common agreement as to its distribution over the farm, but if it be accepted that rent represents some return on the cost of reclamation and equipment and nothing more, it is obvious that it should be divided over the farm upon an acreage basis.

The question of a charge for *Interest* also requires consideration. If it be accepted that the cost of an article can be nothing more than that which is paid for it, it is clear that interest on capital is not a charge against cost, and as a general rule

* Clay, H., *Economics*, p. 356.

accountants appear to be agreed about this. In estimates of agricultural costs appearing from time to time in the press, the practice of charging interest is one of the commonest errors, the argument being, apparently, that the farmer is entitled to charge, as part of his cost, such a sum as the capital involved could have earned had it been invested in some other security. Money in the form of capital invested in, say, War Loan cannot be used to produce milk or other farm produce; therefore there cannot be a charge against milk of the sum which the money would have earned if employed in War Loan. It is, of course, of vital importance to the farmer to consider, from time to time, what rate of interest he is getting on his farming capital, but he must not attempt to anticipate this calculation by including interest charges in his costs. The proper time to do it is when his balance-sheet for the year is before him. A milk producer may find that on a capital of £10,000 invested in his farm he has obtained a profit of £1,500. From high class securities he could have obtained an income of £600 by the investment of a similar amount; from good industrials, £800; from speculative investments, £1,000 or so; and in each of these cases he would be free to be employed in some salaried capacity. It is then for him to decide whether, having regard to other opportunities available for the investment of his capital and the alternative employment of his own time, he would be better advised to give up farming. Interest on the farmer's own capital is an allocation of profits: interest on borrowed capital is a charge against profits. But in neither case is it a charge against cost, and to include it in cost is to produce a figure which is not cost at all, but cost *plus* a certain margin of profit.

Another common error in statements of costs is the inclusion of a charge for *Management*. This has to be considered in the price, not in the cost, and, as indicated above, the amount earned by the farmer is a matter to be ascertained from the profits. If charges for the farmer's own management, as distinct of course from paid management, and for interest on his capital, are included as costs, the resultant figure represents the price at which the article can be sold to the consumer to give the necessary margin of profit to the producer. For the farm accountant to call it "Cost of Production" shows a lack of clear thinking or is an attempt to impose on the credulity of the public. In the long run both these charges have to be reckoned with if supply is to be maintained, but as

they are not actual cash transactions, and there is no basis for assessing them, they are not charges with which the cost accountant can deal.

A system of Management Book-keeping based on the foregoing principles, and carried out with figures supplied from adequate farm records, will furnish a complete economic review of the organisation of the farm for production, which should form the foundation both of the practice and of the teaching of agriculture. It is too much to expect that those already engaged in the industry can devote the time necessary to the study of the subject to make practical use of it in their daily work, but those responsible for the education of the coming generations of agriculturists can do no greater service to the industry than direct attention to the study of these too-long neglected subjects.

THE MODERN BEE-HIVE: ITS DEFECTS AND POSSIBILITIES.

TICKNER EDWARDES.

ONE of the mysteries of the country-side most puzzling to students of English village-life, is the decline—one might almost say the extinction—of cottage bee-keeping.

While well within the recollection of many hardly to be called old, the sight of a row of straw skeps in a village-garden was a common incident of a day's tramp in the country, a bee-hive is now the last thing the rural wayfarer would expect to come upon. He will see small fowl-runs in plenty, corners full of rabbit-hutches on stilts, and even pigstyes where farmers are altruistic enough to allow their labourers to instal them. For some unfathomable reason, however, the British cottager seems to have given up keeping bees, with the result, as all lovers of old Virgil's gentle craft well know, that many tons of valuable sweet-food are being annually lost to the people.

The mystery cannot be explained on the plea that our villagers are scared by the prevalence in recent years of the notorious "Isle of Wight" bee-disease. No doubt this affection, since its recrudescence some seventeen or eighteen years ago, has swept away thousands of bee-colonies, and many of the more timid hive-owners may have thus dropped out of the craft altogether; but cottage bee-keeping in this country was in full decline long before "Isle of Wight"—or Acarine—disease had been even thought of. The cause of the decline, if it be discoverable at all, must be looked for in quite another direction; and, in the writer's view, based on the experience of a long life spent in various southern English villages, the present unpopularity of bee-keeping among our cottage-folk must be largely attributed to a very simple and very human cause—a constitutional apprehensiveness in the rising generation.

The old bee-masters were as tough of heart as they were of skin. They thought nothing of a sting or two. To anyone qualified to judge, however, the fact is undeniable that among present-day village-folk, there exists very generally a mortal dread of the honey-bee's stiletto. The thing is obvious wherever you go. Scarce one but will tell you tales of father's or grandfather's prowess with bees, but when asked why they themselves do not maintain the family tradition in the

craft, they have only the one answer for you—a smile, a shrug of the shoulders, and a shake of the head. The children, it seems, are to go without this incomparable sweet, with its wonderful richness in vitamine, and be brought up on rickety beet-sugar, just because father will not risk his precious skin.

The production of honey and its hardly less valuable concomitant beeswax, is, however, by no means necessarily a hazardous business. All varieties of the honey-bee have their vicious strains, it is true, and many bee-keepers persist in retaining these strains in their apiaries for the reason, indisputable, that they are often splendid honey-makers. Yet it is equally true that bees of even temper exhibit just as good working qualities; and, setting bravado aside, no one, particularly one's neighbours, is obliged to put up with the nuisance of vindictive bees. In the course of the whole of last season a well-known apiarist who has studied this matter, received only two or three stings from his own bees, and these he ascribes entirely to his own carelessness. The writer, over the same period, can remember being stung only once, though his season's work included the frequent opening of hives, the taking of swarms sometimes in difficult situations, and the continual handling of honey-supers.

Safety and comfort in beemanship depend, in the first place, on having bees of quiet disposition; and, second and last and all the time, on deft, deliberate, gentle handling dictated by knowledge, together with abstention from fussy and needless interference with the bees. Probably the old maxim—that all knowledge worth having must be paid for—is as true in the attainment of proficiency in bee-craft as in anything else; but it cannot be too widely known that the production of honey and wax is no more likely to prove, nor necessarily to be regarded as, a prickly pursuit, than the cultivation of gooseberries. Indeed, as far as personal safety goes, the writer would far rather superintend a score of bee-hives than have the charge of one moderate-sized gooseberry-patch.

The avowed purpose of these observations is to advocate a return to the ancient and profitable pursuit of bee-keeping by our cottagers and smallholder class of country-dwellers, as a practical contribution to the elucidation of the problem of making life easier for the small man on the land. It is not intended, however, to deal with the details of modern bee-keeping methods, but rather to indicate a few of the broad principles on which the success of small apiculture depends.

The production of honey and beeswax is essentially a local industry. Very large apiaries located on one spot are economically unsound, for the simple reason that a given district, however rich in flora, is capable of employing profitably only a definite small number of colonies, seeing that the effective range of the honey-bee's flight is generally limited to a radius of, perhaps, a couple of miles. Bee-keeping pure and simple, is therefore, by a law of nature, reserved for the small man, and must ever remain so while our present system of agriculture lasts. There may come a time when planting exclusively for honey and wax production may develop into a payable project, and then, by degrees, large apiaries will probably oust the smaller ones altogether: but to consider that now would be a mere utopian "dealing in futures." The visible logic of the situation is to regard honey and beeswax as, what they essentially are at present, by-products of other rural commodities, and beemanship a sort of wholesale gleaning. For we are all gleaners at present, and nothing more, though it is just "with your will or by your will" in respect of the farmers: they must let our winged thousands pass whether they will or no. The bee-keeper, indeed, is in this enviable position--he pays nothing for his raw material, nothing in wages, and his labourers toil unremittingly for him while at the same time supporting themselves. His own contribution to the enterprise is merely a warehouse and factory costing a few shillings, a little of his spare time, and an odd corner of garden-space. No wonder it has become a truism that bee-keeping on modern scientific lines can be made to pay cent. per cent.

This statement is literally true, but it needs accurate definition and qualification. Bee-keeping will not pay unless a clean sweep is made of many erroneous notions, both new as well as old. There is perhaps no other pursuit in which such wide diversities, even contrarieties, of opinion and method exist among its professed exponents, all of whom, however, command a certain measure of success. At first this seems hopelessly paradoxical, until one realises the fact that the redoubtable honey-bee will "make good" to a certain extent under almost any conditions: if not because of the bee-keeper's methods, at least triumphantly in spite of them. All that, however, involves a great waste of bee-acumen and energy intolerable in these urgent days. The conclusion of the whole matter is that the deeper knowledge we get of the great unalterable principles underlying hive-life as exploited by the

bees themselves, the better we can make our colonies pay. It is to one in particular of the more outstanding of these principles, rather than to the general, accepted, practical daily routine of bee-craft, that we should now address ourselves.

It would be absurd, of course, to say that successful honey-production depends upon the kind of hive in which the bees are housed, although, hyperbolically, the phrase may be admitted. The dauntless nature of the honey-bee—her age-long triumph over difficulties set in her path by the ignorance of man—comes clearly to light under even the most cursory study of ancient beemanship. Nor does a review of bee-keeping methods in vogue in times comparatively modern, reveal any better understanding of the bees' requirements in the matter of hives as a result of nearer acquaintance with their true habits. It is a literal fact that there was no such thing as a bee-hive, in any sense worthy of the name, in existence in any country, until about three hundred years ago, when Sir Christopher Wren devised his octagon hive, inaugurating what is known as the "storification" principle. In bee-craft this was an epoch-making event, for Wren's hive afforded the domesticated honey-bee a thing which her winged sister of the wilds had easily secured for herself by building in a hollow tree—a domicile capable of expansion to meet the growing needs of the colony. But Wren's hive only provided for expansion *downwards:* that is to say, extension of the actual brood-nest, the nursery-quarters of the hive. It was left to a Scotsman, of characteristic racial intelligence, to discover, some century and a half later, that bees in a natural condition carry their surplus honey-stores *upwards*. And so the famous Stewarton hive, with its easily added upper storeys, and its resulting extraordinarily increased honey-yields, came into being.

The paramount stage, however, in the evolution of the modern bee-hive, was not reached until the year 1834, when the principle of the movable-comb hive was discovered by Major Augustus Munn, although the honour of priority for this invention is, it is believed, claimed by several other countries. The movable-comb hive at once transformed bee-keeping from a black art into an authentic though very immature and youthful science. The trouble in the present day is that the science of bee-keeping thus initiated, has, from the very first, been handicapped by an incorrigible, Peter Pan-like propensity of not being able to grow up. The movable-comb frame idea

was at once grasped by all bee-keepers, and as soon as it was discovered that these frames could be fitted with thin sheets of beeswax—impressed all over on both sides with a hexagonal pattern to represent cell-bases, which the bees would readily draw out into comb—then the craft came into possession of a thing which worked a complete revolution in the honey and wax industry. For the first time it then became possible to "manage" a hive—to add new frames to the brood-nest when the queen required more room for egg-laying; to do away with old clogged and useless combs and substitute good ones; to take combs of brood from over-populous colonies and give them to less forward ones; to control the breeding of drones by limiting the area of drone-comb in the hive, and by closer inter-spacing of the combs; to get at any part of the bee-city at a moment's notice for renewal of queens, or any other of a variety of operations; to prevent swarming by cutting out queen-cells, giving more room in the brood-nest by emptying existing combs of their honey, and adding comb-space for the queen; to make artificial swarms when required; and, above all, to keep up an inexhaustible supply of honey-combs, these being taken away as soon as filled, the honey in them removed by the centrifugal extracting machine, and the empty combs returned at once to the hive to be filled again. This latter possibility alone, by saving the bees the labour and time needed for comb-building just when both labour and time were most precious—during the height of the honey-flow—stamped the movable-comb hive as a veritable triumph of utility, and at once made it possible to obtain twice as much honey as heretofore from any given stock.

In so far as a full exploitation of the advantages of the movable-comb system is concerned, bee-keepers have indeed little with which to reproach themselves. In the matter of hives, however, we are in a very different case. It is here that bee-keeping science has kept its pristine babyhood almost intact. The straw-skep age was succeeded by an age of plain wooden box-hives; and the hive of the present day, for all its ingeniously contrived interior, remains a box and nothing more. Yet it should be a great deal more. It is vital, in fact, to the whole future prosperity of the craft that bee-keepers should generally recognise prevailing deficiencies in hive-construction and set about remedying them without delay.

The main fault of almost all hives obtainable commercially at the present time, is that their walls are too thin. This may, at first glance, seem an immaterial point, provided that the

hive is capable of excluding all moisture and draught—but this is not so. An indispensable quality in a good hive is that it should be in a very high degree both heat-retaining and heat-resisting, and in these qualities almost every hive at present on the market is lamentably wanting. If there be one principle more than another which the writer's long practical experience has established beyond a doubt, it is the necessity for double walls in a bee-hive. Nor is it enough to construct the hive of two shells, one fitting loosely within the other. This is better than the single-wall pattern, but it fails in several important particulars, even when the space between the two shells is packed with a heat-intercepting material such as chaff. Packing of this nature is liable to get damp, when it soon changes into a mass of corruption; and if merely left loose between the cases, it proves an unmitigated nuisance, should either of them need to be disturbed. Practicability rules all packing devices out of court, unless the material be securely enclosed. Indeed, its use is rendered superfluous, because dead-air—a perfectly confined empty space—is by far the best heat-retaining medium known. A good hive, therefore, at least as far as concerns the brood-nest, must have all its four sides composed of dead-air cavity-walls, preferably not less than three inches thick over all.

The writer is well aware that in insisting on this point, he is running counter to the notions, or want of notions, in the majority of bee-keepers, and is especially likely to embroil himself with "the trade." It is admitted that a clever and careful bee-master can make bees thrive to a certain degree in almost anything: admitted also the logic—though not the morals—of the position that while single-walled hives, easy to construct, can be readily sold, it would be folly to push the sale of another article, however superior, which is troublesome and expensive to make. Despite the trouble and cost, however, stress must here be laid not on the superiority alone of double-walled hives, but on the downright necessity of them, where the bee-keeper looks for the best return on his outlay.

In such hives, properly designed and put together, it is definitely claimed that the bees will remain healthier at all seasons, will consume a smaller amount of food during winter, will make more speedy progress in numerical strength throughout the spring, and, because they thus reach the brink of the summer nectar-flow with a larger population of workers, will certainly collect more honey for their owner. The cottager and smallholder, therefore, to whom these observations are

mainly addressed, is earnestly counselled to adopt this system of housing his bees as one of the principal points in profitable apiculture.

Indeed, it is scarcely possible to extract the fullest advantage from the modern movable-comb hive system under any other procedure. Damp is the chief enemy of hive-life, and probably the main exciting cause of nearly all diseases of bees. A stock housed in a brood-chamber which can be kept both warm and dry, and at the same time freely ventilated, will retain health and thrive in the face of continued adverse weather conditions, where colonies housed in the single-walled hives will come hopelessly to grief. The reason for this is not far to seek. The arguments follow each other in a vicious circle. Single walls mean cold walls. Cold walls mean perpetually damp walls as regards their insides, because the warm vapour incessantly given off by both bees and ripening honey, condenses on them; whereas with double walls, the interior surface of which remains as warm as the rest of the brood-chamber, this vapour passes harmlessly out of the hive. Damp walls mean damp combs and an incessant lowering of temperature, which the bees try to counteract by extra feeding; and extra feeding, combined with inaction during periods of confinement to the hive, means dysentery and possibly worse.

When we make the walls of our hives perfectly non-conducting to heat, we cut at the root of all this mischief. Then, instead of a vicious circle of arguments, we have a benevolent one. Double walls mean warm walls. Warm walls mean permanently dry walls, and these again ensure a whole hive-interior dry and of uniform temperature. In winter the bees are comfortable, their hibernation is more complete, and so they require less food. Brood-raising in early spring forges ahead betimes. In the summer heats the hive remains cool, and the tendency to swarming is lessened. Moreover, because the hives keep dry under all conditions, the bee-keeper can leave their entrances wide open at all times of year, thus providing abundant means of ventilation; and plenty of fresh air means hardy, vigorous, disease-resisting bees. It stands to reason that bees of that fettle must always prove the best honey-makers.

In the end, therefore, at the cost of a little extra trouble and timber, the cottager has not only given his children an unlimited supply of body and brain-building food throughout the year, but has probably paid his rent, and butcher's and baker's bills into the bargain.

IMPROVEMENT OF GRAZED PASTURES BY MANURING.

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GENERAL conclusions obtained from the results of a series of experiments on the improvement of hill and peaty pastures laid down by the Department of Agriculture, University College of North Wales, Bangor, have been published by that Department in pamphlet form.*

These experiments were made in 1913, 1914 and 1915, and were all on a uniform plan, as shown in Table I.

Table I.—Plan of Experiments.

Manure per Acre.

Plot	I.	10 cwt. Basic Slag, 42 per cent. total phosphate, 33·6 per cent. citric soluble phosphate.
,,	II.	10 cwt. Ground Gafsa Phosphate, 62 per cent. total phosphate, 22·4 per cent. citric soluble phosphate.
,,	III.	6 cwt. Superphosphate, 30 per cent. phosphate.
,,	IV.	No Manure.
,,	V.	Superphosphate as for Plot III, with the addition of 20 cwt. Ground Lime.
,,	VI.	20 cwt. Ground Lime.
,,	VII.	36 cwt. Ground Limestone.

The plots were also cross-dressed with a potassic manure, viz., 1½ cwt. sulphate of potash per acre in the earliest experiments and 6 cwt. of kainit per acre in the later experiments.

These experiments were made at a number of centres throughout North Wales. Although valuable results were obtained, at most of the centres the ground was not sufficiently uniform to give reliable results from botanical analyses. Only at five centres, therefore, were botanical analyses of the herbage made, all primarily in the fourth summer of the experiments. At one of the centres, the results were practically nil, while the botanical results only showed that leguminous plants were entirely absent from the herbage.

At a second centre, where the soil was a neutral peat and the herbage approximately that of the fen type, there was no change which might be considered to be an agricultural

*** The latest pamphlet, "The Improvement of Rough Pasture," was issued early in 1920. The writer is indebted to Professor R. G. White for particulars of these experiments. The work here recorded was done while the writer was attached to the Department of Agriculture at Bangor.**

improvement, and the chief botanical result was a distinct increase, both in number and vigour, of *Juncus subnodulosus*, following the application of basic slag, superphosphate and superphosphate with ground lime. The most interesting feature of this experiment, however, was that ground Gafsa phosphate had no effect whatever.

At the other three centres, very marked results were obtained, but, unfortunately, owing to some doubts as to the uniformity of the soil, three of the plots at Centre A and one at Centre C have been ruled out.

All the results given here were obtained by the Percentage Frequency method. This method has the effect in some cases of obscuring some important features, particularly the effect of treatment upon the density of the herbage as revealed by the number of plant units per unit area. For this reason, aggregate results are given in terms both of plant units per unit area, and percentage frequency, the unit area selected being 36 sq. in. To give detailed analyses would mean very long tables, and although these would be interesting, the results for many plants occurring only in relatively small quantities would not be sufficiently definite to be of much value. Only the most important plants are, therefore, included in the detailed results.

The Effect of Potash.—At none of the centres where botanical analyses were made was there any indication that potash had any appreciable effect. At another centre, however, on well-drained, deep, acid peat, it had a marked effect. On the "No manure" plot, it had the effect of increasing Knapweed (*Centaurea nigra*) in a very conspicuous manner, but this was not seen where the potash was used with other manures. The greatest improving effect was obtained when potash was used with superphosphate and ground lime, but it was also clearly seen on the basic slag, Gafsa phosphate, and superphosphate plots.

No marked difference could be seen between the basic slag and Gafsa plots, although White Clover was more developed on the latter. Both were obviously superior to the superphosphate plot, which, however, showed considerable improvement over the unmanured plot.

All three plots showed a marked increase in the number of plant units per unit area. It is interesting to note (Table II) that the number of grass units increased equally on the basic slag and Gafsa plots. There was a considerably greater increase in grass units on the superphosphate plot, but the

Centre A: Penlan, Llangollen, Denbighshire:—

Field: Old pasture in poor condition, continuously grazed, naturally well-drained.
Soil: Shallow, medium loam on shaly brash.
Altitude: 1,250 feet.
Rainfall: Probably about 50 inches.

Table II.—Aggregate Results for Centre A. Fourth Summer.

	Manure used :—	Basic Slag.	Gafsa Phosphate.	Superphosphate.	None.
Plant units per unit area	Gramineæ -	258	258	290	200
	Leguminosæ -	66	107	40	8
	Miscellaneous	28	27	27	26
	Total - -	352	392	357	234
Percentage Frequency	Gramineæ -	73·3	65·8	81·2	85·5
	Leguminosæ -	18·7	27·3	11·2	3·4
	Miscellaneous	8·0	6·9	7·6	11·1
		100·0	100·0	100·0	100·0

increase of leguminous plants was least on this plot. There was actually very little change in the miscellaneous plants, but owing to the other changes involved they would appear from the percentage results to have decreased.

At this centre, Gafsa phosphate clearly had the greatest effect on the aggregate botanical composition of the herbage, while its effect upon the leguminous plants was considerably more marked than that of basic slag.

Table III.—Some Detailed Percentage Results for Centre A. Fourth Summer.

	Basic Slag.	Gafsa.	Superphosphate.	None.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Agrostis tenuis - -	45·7	40·6	59·0	73·1
Holcus lanatus - -	6·8	4·0	5·8	2·1
Festuca rubra - -	6·5	8·3	6·1	3·0
Cynosurus cristatus -	9·6	6·8	3·0	2·6
Anthoxanthum odoratum	4·5	6·1	6·6	4·3
Trifolium repens - -	14·2	25·0	10·2	1·7
Lotus corniculatus -	4·5	2·3	1·0	1·7

One of the chief features shown by Table III is that the proportion of Bent grass was decreased by all three manures, while that of the other grasses was increased. The extent of the change varied considerably in some cases. Gafsa phosphate gave a remarkable increase of white clover.

Centre B: Ffridd, Rhyd-ddu, Carnarvonshire:—

Field: Very old pasture, continuously grazed, good natural drainage.
Soil: Thin acid peat on local drift.
Altitude: 900 feet.
Rainfall: Very high (probably about 100 inches).

Owing to a very marked change observed in the herbage of some of the plots at this centre by the sixth summer, the percentage frequency examination was made both in the fourth summer and in the sixth.

Table IV.—Aggregate Results for Centre B. Fourth and Sixth Summers.

		Manure used :—	Basic Slag.	Gafsa phosphate	Superphosphate.	None *	Superphosphate with Ground Lime.	Ground Lime.	Ground Limestone.
FOURTH SUMMER.	Plant units per unit area	Gramineæ ...	328	298	266	229	293	277	275
		Leguminosæ...	95	93	75	13	94	70	27
		Miscellaneous	31	15	22	23	24	18	16
		Total .	454	406	363	265	411	365	318
	Percentage Frequency	Gramineæ ..	72·2	73·4	73·3	86·4	71·3	75·9	86·5
		Leguminosæ...	20·9	22·9	20·7	4·9	22·9	19·2	8·5
		Miscellaneous	6·8	3 7	6·1	8·7	5·8	4·9	5·0
		Total ...	99·9	100·0	100·1	100 0	100·0	100·0	100·0
SIXTH SUMMER.	Plant units per unit area	Gramineæ ...	280	290	268	208	320	301	304
		Leguminosæ..	18	6	4	9	54	66	46
		Miscellaneous	47	23	31	15	31	24	27
		Total ...	345	319	303	232	405	391	377
	Percentage Frequency	Gramineæ ...	81·2	90·9	88·4	89·7	79·0	77·0	80·6
		Leguminosæ ..	5 2	1·9	1·3	3·9	13·3	16·9	12·2
		Miscellaneous	13 6	7·2	10·2	6·5	7·7	6·1	7·2
		Total ...	100 0	100·0	99 9	100·1	100 0	100·0	100·0

* Average figures for three untreated plots. The figures for these three plots varied but little.

In the fourth summer, the most improved plots appeared to be those on which basic slag, Gafsa, and superphosphate with ground lime were respectively applied, but improvement was also noticeable on the superphosphate and ground lime plots. On the ground limestone plot improvement was very small. Table IV shows that at this time there was also a very marked difference in the herbage of the plots. On the most improved ones, there was a very marked increase in the number of plant units per unit area, especially on the basic slag plot, and a striking feature is the similarity of the figures for Leguminosæ on the three most improved plots. In the percentage results, this similarity is obscured and the figures for leguminous plants are relatively near each other for the five most improved plots.

Similarity between the figures for the ground lime and superphosphate plots is also observable.

By the sixth summer, the basic slag, Gafsa, and superphosphate plots were in a bad state. The first two plots had a patchy appearance, with a considerable proportion of practically bare soil, while the superphosphate and the unmanured plots appeared to be exactly alike. The superphosphate with lime and the ground lime plots were, on the other hand, in excellent condition, while the ground limestone plot was much improved. As will be seen from Table IV, the unmanured plot had suffered relatively little change in the interval, but the change in Plots I, II and III was very marked, the leguminous plants having all but disappeared. At the same time, there was a decrease of these plants on the superphosphate with lime plot, but the percentage composition of the herbage was still good. The change on the ground lime plot was relatively small, but there was a considerable increase in the gramineous plant units per unit area. These aggregate figures do not show any great difference between the first three plots in the sixth year, but, as will be seen from Table V, the superphosphate plot was much more nearly similar to the unmanured plot than either the basic slag or the Gafsa plots.

Table V.—Some Percentage Frequency results for Ffridd Obtained in the Fourth and Sixth Summers after Treatment.

	Manure used :—	Basic Slag.	Gafsa Phosphate.	Superphosphate.	* No Manure.	Superphosphate with Ground Lime.	Ground Lime.	Ground Limestone.
FOURTH SUMMER.	*Agrostis* spp.	33·8	31·9	17·7	22·7	21·9	16·1	15·9
	Festuca ovina	17·4	25·9	37·0	41·9	34·6	38·9	48·2
	Molinia cærulea ...	0·1	0·5	3·9	7·1	2·7	3·4	7·5
	Anthoxanthum odoratum	5·3	2·6	3·6	2·9	1·0	3·2	2·7
	Trifolium repens ...	20·9	22·9	20·7	4·9	22·9	19·2	7·6
	Potentilla erecta ...	0·5	0·2	0·4	2·0	1 5	1·0	1·6
	Sagina procumbens ...	2·4	1·2	—	0·5	2·4	1·9	1·2
SIXTH SUMMER.	*Agrostis* spp.	47·1	58·4	21·0	18·8	28·1	22·2	22·8
	Festuca ovina	6·1	5·3	27·9	40·5	39·3	36·6	35·0
	Molinia cærulea ...	2·0	0·6	4·4	4·9	3·3	2·0	4·0
	Anthoxanthum odoratum	5·5	1·9	—	2·3	—	1·5	2·7
	Trifolium repens ...	5·2	1·9	1·3	3·9	13·4	16·9	12·2
	Potentilla erecta ..	1·2	0·9	0·2	0·6	2·0	2·8	2·7
	Sagina procumbens ..	2·3	2·5	0·4	—	2·2	0·8	0·5

* Average for three untreated plots, one at each end of the series, the other in the centre. The figures for these three plots varied but little, *e.g.*, *Agrostis* :— 23·8, 23·7, 20·5 per cent.

It would appear from the figures in this table that the balance of the herbage on the slag and Gafsa plots was so upset that it was unable immediately to return to its original state, but immediate reversion was possible on the superphosphate plot when the effects of the manure were exhausted.

The effects of slag and of Gafsa phosphate are particularly marked upon some plants. It is curious to note that *Agrostis* spp. were much increased even by the fourth summer, when the plots were in excellent condition, while by the sixth summer there was a further increase, although the plots were then in a very poor condition. Some of the other plots showed very little change or decrease by the fourth summer, and, except on the superphosphate with ground lime plot, the development of *Agrostis* was not far from normal in the sixth summer. *Festuca ovina* was even more markedly affected by slag and by Gafsa phosphate, but on the other plots it suffered relatively little. There was a marked decrease of *Molinia* on the most improved plots, but relatively little on the others.

From these results, it would appear that, under the conditions of the experiment, (1) a marked improvement may be accompanied by such a change in the botanical composition of the herbage that, when the direct effect of the manure has been exhausted, the herbage may become even poorer than it was originally; (2) an increase in *Agrostis* spp. may accompany a marked improvement; (3) a decrease of *Festuca ovina* may also occur when an improvement takes place, and, in extreme cases, may almost disappear as a result of treatment which has given a great improvement; (4) an increase in *Trifolium repens* accompanies an improvement, while a decrease accompanies a deterioration ; (5) *Sagina procumbens* shows an increase with improvement, and may maintain or even improve its increase with the deterioration which follows improvement, if the general balance has been so upset that direct reversion to original condition is not possible.

Centre C: Ffyddion, near Caerwys, Flintshire:—

Field: Very old pasture, continuously grazed, rather flat, but naturally well-drained.
Soil: Mostly rather heavy loam on clay drift over limestone.
Altitude: About 650 feet.
Rainfall: About 40 inches.

The plots at this centre were also examined by the Percentage Frequency method in the fourth summer after the application of the manures. Part of Plot VII was on rather lighter soil than the other plots, and the results obtained are not, there-

fore, included in the tables. Results on the "No manure" plot are the average for two such plots, one ground adjoining the basic slag plot and the other in the position shown in the tables.

Table VI.—Aggregate Results for Centre C. Fourth Summer.

	Manures used :—	Basic Slag.	G fsa Phosphate.	Super-phosphate.	None.	Super-phosphate with Lime.	Ground Lime.
Plant units per unit area	Gramineæ -	380	387	256	220	313	191
	Leguminosæ -	87	107	50	7	69	12
	Miscellaneous	33	27	34	59	44	45
	Total - -	500	521	340	286	426	248
Percentage Frequency	Gramineæ -	76·0	74·3	75·3	76·9	73·5	77·0
	Leguminosæ -	17·4	20 5	14·7	2·4	16·2	4·8
	Miscellaneous	6·6	5·2	10·0	20·6	10·3	18·1
	Total - -	100·0	100·0	100 0	99 9	100·0	99·9

In the fourth summer (and in other years also) it was clear from the appearance of the plots that the most successful were, as usual, those on which basic slag, Gafsa phosphate, and superphosphate with ground lime had been applied. The ground lime plot showed no improvement whatever, and, if anything, it was rather poorer in appearance than the untreated ground. Ground limestone showed a very slight improvement, while the improvement on the superphosphate plot was well marked, although the line between it and the adjoining Gafsa plot was easily traceable. In this case, again, the results show (Table VI) that on the most improved plots there was a very marked increase in the number of plant units per unit area. Differing from the other centres, however, the miscellaneous plants were much affected in the aggregate, but in the original pasture they stood at a relatively very high figure. The decrease of these plants on certain plots was, however, so well distributed amongst the various species that the changes in individual species were generally insignificant.

It is of some interest to note that, in spite of the underlying rock (at no great distance from the surface), the greatest change was brought about by Gafsa phosphate.*

Table VII shows that here, as at Centre B, a marked improvement may be accompanied by an increase of Bent grass, although there was no marked change on the superphosphate with lime plot.

*At one centre only was Gafsa phosphate inferior to basic slag, and that was on a deep neutral peat in Anglesey. At this centre Gafsa had no effect whatever, while slag had a marked effect.

Red fescue increased on the most improved plots and also on the ground lime plot. On close examination, it was found that the appearance of the grass differed greatly in the two cases. On the ground lime plot the stems were purplish and the grass unattractive, while on the improved plots it was of excellent colour and well grazed.

The two grasses which seem to have been affected most are *Sieglingia decumbens* (*Triodia*) and Quaking Grass. Both were greatly reduced on the most improved plots. Even ground lime had caused some decrease.

Yorkshire Fog, on the other hand, increased on the more improved plots, but not in proportion to the extent of the improvement. The increase on the superphosphate with lime plot and the decrease on the ground lime plot appear to indicate that, under the conditions of the experiment, treatment had a special effect upon this grass.

As usual, a marked improvement was accompanied by an increase in Leguminosæ, especially White Clover, and this increase was exceptionally marked on the Gafsa plot.

Table VII.—Some Percentage Frequency Results for Centre C. Fourth Summer.

	Basic Slag	Gafsa Phosphate.	Super-phosphate.	None.	Super-phosphate with Ground Lime.	Ground Lime.
Agrostis tenuis	43 8	39·5	41·3	34·5	36·9	39 1
Festuca rubra	15·8	20·9	13·2	12·5	18·5	19·8
Anthoxanthum odoratum	4·4	4·1	3·8	1·2	3·5	4·8
Sieglingia decumbens ..	1·6	0·6	2·6	6 5	0·7	4·8
Holcus lanatus .	5·6	6·4	6·2	4·5	11·0	—
Briza media	0·8	1·5	6·7	13·7	2·6	8·5
Trifolium repens ..	15·6	20·0	18·5	1·3	15 5	2·4
Lotus corniculatus	1·8	0·5	1·2	1·2	0·7	2·4

Summary and Conclusions.—The main object of this article is to place on record and render available some botanical data obtained from manurial experiments under three different sets of conditions on very poor pastures in North Wales. For this reason, no attempt has been made to discuss the results at all fully. From the data given, however, the following conclusions may be drawn:—

(1) At all three centres a very marked improvement was observed on some of the plots. (This was, however, not the case at some centres where similar experiments were carried out.)

(2) At each centre, a marked improvement was accompanied by a marked increase in the total number of plant units per unit area, and this increase was apparently in proportion to the extent of the improvement.

(3) Marked improvement was also invariably accompanied by a corresponding increase in the proportion of White Clover.

(4) In one case, improvement was accompanied by a decrease of the proportion of Bent grass, which, however, stood originally at a high figure. At the other two centres, the proportion increased as a result of improvement.*

(5) At one centre Sheep's Fescue was profoundly affected by basic slag and by Gafsa phosphate.

(6) In general, equal quantities of high-grade basic slag and ground Gafsa phosphate gave nearly equal results, but the botanical data strongly suggest that Gafsa phosphate was the more effective. In one case, improvement by means of these manures was quickly followed by a great deterioration, and it would appear that the changes induced by them in the first instance were so great that the pasture was incapable of reverting directly to its original condition.

(7) Superphosphate with ground lime gave very good results, which were, perhaps, not quite so good as those given by the two manures already mentioned. At the particular centre referred to above, there was not such rapid deterioration as with basic slag and Gafsa phosphate.

(8) Superphosphate alone was in all three cases inferior to the manures already mentioned, but it produced a considerable improvement. With this manure, the deterioration which followed the initial improvement at Centre B consisted of a reversion of the herbage to its original state.

(9) Only at one centre did ground lime alone effect an improvement.

(10) Results for ground limestone are given for one centre only, where it was more effective than at any other centre. Even here, however, its action was very slow.

* Cf. Stapledon, R.G.: "Pasture Problems: The Response of Individual Species under Manures." *Jour. Agri. Sci.*, Vol. VI. Part IV, 1914.

MARKETING OF FRUIT.

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IN considering this subject it must not be forgotten that in the early days the bulk of the fruit was grown in the vicinity where it was needed and the transport was more or less limited to a few miles. For this reason there sprang up many localised industries in fruit growing near the populated areas. Questions of grading and packing and the kind of packages necessary did not weigh very heavily with the producer of the fruit, and he used such packages as were convenient. The Kentish and Middlesex men found that round baskets, hampers and half-bushel baskets were the most convenient for trade with the London shops, whereas Evesham fruit growers preferred to use a square basket of the type now known as the Evesham pot. Other districts used flats or barrels. All proved equally satisfactory for the carrying on of this purely local business.

In more recent times, with the advent of steam engines and railways in the country, making the transport of fruit possible over long distances, the limitations of districts suitable for the production of fruit no longer obtained. Soil and climate then became the more important factors, and where these were suitable for the production of fruit the industry grew, and important fruit growing areas were developed in many parts of the country. Even growers engaged in the cider industry in the West of England were attracted and turned their attention to the possibility of the production of table fruit instead of cider fruit. In spite of this development the supply of home grown produce was seldom, or never, sufficient to meet the ever-increasing demand for fruit by the urban dwellers and workers of the large industrial centres.

The introduction of powerful and fast ships made it possible for growers so far away as Canada, South America, Australia and Tasmania, to send to our markets certain varieties of fruit to help to satisfy this demand, by supplying varieties which came on to the markets after the bulk of the home-grown fruit had been consumed.

Imported Fruit.—For shipment purposes growers in other countries soon discovered the futility of sending anything but good class sound fruit, packed in such a manner as to reduce the risk of bruising to a minimum. Thus they evolved the system of grading and packing, and brought into use the wooden

boxes and barrels now so well known on the markets. Legislation fixing certain standards of grades and packages, and measurements of boxes and barrels, is of more recent introduction. It has no doubt stimulated and hastened forward a movement which was started voluntarily.

The exporters soon realised also, that to secure repeat orders similar classes of consignments should be branded or labelled with distinctive and guaranteed marks, and for continued business a large bulk of a very few varieties would be needed. Experience in marketing soon established these facts, and growers in other countries soon adapted their industry to meet these conditions.

A study of the figures showing the imports into this country makes it clear that the methods adopted in marketing imported fruit has given satisfaction. It is true that many of these consignments reach this country after the home crop has been consumed; but a portion, and an increasing portion, is marketed here in competition with the home-grown fruit.

The disadvantage in respect of transport to which the imported fruit is placed should serve as a big handicap, yet because of the manner of its presentation such fruit is in favour on the markets, and has in fact made considerable headway in securing a considerable proportion of the trade. For example, in 1919 the apple crops in the British Isles were exceedingly heavy in all districts, yet notwithstanding this, 2,967,284 cwt. were imported from abroad between August and December. These imported apples, in preference to the home-grown produce, were eagerly bought up by retailers, in many instances at prices in excess of those realised for our best samples. This fact illustrates the standing in the British markets that has been secured by the imported produce. It has been stated by wholesalers that as soon as the foreign crop arrives they have considerable difficulty in finding buyers for the home produce, simply because retailers and others prefer a standard article on which they can rely to an article which may, or may not give satisfaction.

Home-grown Fruit.—Something must be wrong with the home industry that such a state of affairs can exist. Is it that the English varieties of fruit are inferior to those grown elsewhere? Or is it that the fruit is presented to the public in a less attractive manner than the imported? Or do both these factors operate together to the disadvantage of the home-grown article?

The majority of people would admit truthfully that well-grown English fruit, with its thin skin, juicy flesh, and pleasing flavour,

is probably as fine a fruit as is produced anywhere in the world, and much superior in flavour to that produced in places where the atmosphere is drier and the heat of the sun more intense. The fault appears to be not in the article but in the methods of packing and marketing—the manner in which it is presented to the public. It therefore becomes necessary to consider the present methods of marketing and distribution, and to see where improvements can be made, what direction reforms should take, and by whom they should be made.

There are, of course, growers in this country who not only pick their fruit carefully, but grade it into convenient sizes before packing into marketable parcels. Such growers experience little difficulty in marketing most of their produce, but their number is not large. Few people in England have seen apples put through grading machines before being properly packed, for even in Kent the practice even now is by no means general. The usual orchard scene with which one is so familiar, especially in the orchards of Somerset and Devon, is that of apples being shaken down from the trees, and picked up and thrown into barrels; or gathered by hand into baskets and then poured in bulk into barrels. Large and small, sound and blemished, perfect and ill-shaped fruit, are all mixed in the same package. When full the package is roughly handled to shake the fruit down tightly, straw is placed on the top and the package is ready for market. Seldom are the packages weighed, for it is generally accepted that the weight of apples in any given receptacle is known, and is constant irrespective of the variety.

Late varieties gathered in bulk and stored in heaps covered with straw in lofts, keep moderately well. The packing of these for the market shows little or no advance on those marketed direct from the orchard.

Better packing and better delivery prevails in the few cases where the grower deals direct with the consumer or the retailer, but the quantity of fruit that is marketed in this way is small compared with that sent to the markets proper. In most cases growers generally are not inclined to treat their packing seriously, the result being that the salesman has either to sell the produce cheap, or to waste time in a busy market and have the goods re-sorted and packed with dear labour. Neither course gives satisfaction to the grower. The retailer buying the unsorted goods is generally dissatisfied. He often finds the best on the top, and a lot of small inferior fruit at the bottom. Possibly too the packages are less in weight than he was expecting. It would not be fair to blame the grower for all these offences, though

no doubt he could, with a litle care, have rectified many of them; for the packages may during transit have been interfered with on rail, and the increase in pilfering during recent years is regrettable. Indeed, complaints as to the transport by rail of fruits continue to increase, and the whole system is giving general dissatisfaction. Transport by motor ensures prompt delivery, less handling of the packages, and consequent less bruising of the fruit, and providing the cost is not materially different this system is likely to be extended for marketing fruit in future.

Sufficient has been written to indicate that reform measures are necessary, and that the growers, the distributors, and transport companies can all assist in helping with them. They should be such as to secure the marketing, in proper packages, of well-graded fruit, to satisfy the just demands of the consumer. Dealing first with the grower's reforms, the question of varieties arises.

In the past growers have been in the habit of planting a few sorts of local importance, and the fascination of multiplying these is clearly shown by quoting as an example, that of an orchard in the West of England no larger than an acre and a half, where no less than 17 different kinds were planted. It is true that some varieties do better than others in certain localities, and that some elasticity must be afforded to the grower when making his selection for planting; but it seems important that the whole industry should meet together to draw up a list of varieties which may be regarded as of commercial importance. It is not expected that all of these would do well in any one district, or in all classes of soil, but most growers would be able to make a selection to suit their needs. If this scheme were adopted, varieties which are useless or are unknown on the market, would in time be eliminated, and a large quantity of the agreed kinds would be produced. The public generally would become acquainted with these kinds and ask for them. Salesmen and retailers could rely on a large bulk of a few sorts and would be in a position to give repeat orders.

The varieties included in the list should be subject to alteration from time to time, in order that new introductions of decided promise might be added, and worn out or unprofitable sorts struck off.

When the grower has planted the varieties of fruit that are required by the consumer, he should endeavour, by the adoption of up-to-date hygienic measures in his orchards, to produce clean fruit free from blemish, and in picking to handle it with care, so that it may be presented to the consumer in a fit manner.

RESEARCH IN ANIMAL BREEDING.

III.

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In the previous articles of this series, published in the April and May issues of the JOURNAL, *Prof. Punnett dealt with the coat colours in cattle, and the crossing of polled with horned cattle as illustrations of simple Mendelian inheritance.*

THE factorial hypothesis of heredity is, if substantiated, of fundamental importance to the breeder, for it at once raises his operations from an empirical to a scientific plane. It brings certainty where before was only conjecture. Consequently, when animal breeding experiments were started on the University Farm at Cambridge in 1910, it was felt that among the first things to do was to choose one or two cases of apparent blending inheritance, and to study them critically in order to ascertain whether they could be interpreted on the factorial hypothesis. The choice of material was limited to small animals, for reasons of economy. This, however, was no drawback, for small animals can be bred in reasonably large numbers; and we can hardly doubt that what we learn from them is applicable to bulkier and more costly stock. Our work has, therefore, been entirely with poultry and rabbits.

One of the most extensive series of experiments undertaken with poultry was designed to investigate the inheritance of weight. For this purpose two standard breeds were chosen, differing markedly in size, but not so much so as to prevent natural crossing. For the larger breed we selected the Gold Pencilled Hamburgh, and for the smaller one the Silver Sebright Bantam (Plate 1, Fig. 1). As will appear later, the reason for choosing these particular breeds was to make use of the same material for the elucidation of more than one problem. From the point of view of size the two breeds differed sufficiently, for the average weights of cocks and hens respectively were for the Hamburgh about 1,400 and 1,100 grammes, while for the Sebright they were about 850 and 650 grammes. Roughly the Sebrights were about 3/5ths of the weight of the Hamburghs.

The first cross birds were intermediate in size, though approximating to the larger breed, the cockerels averaging about 1,200 grammes, and the pullets about 950 grammes. From several

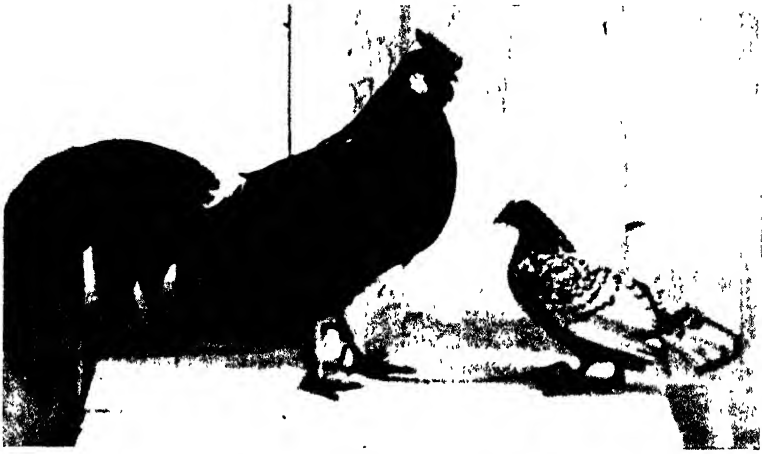

FIG. 1.—Gold-pencilled Hamburgh cock and Silver Sebright hen

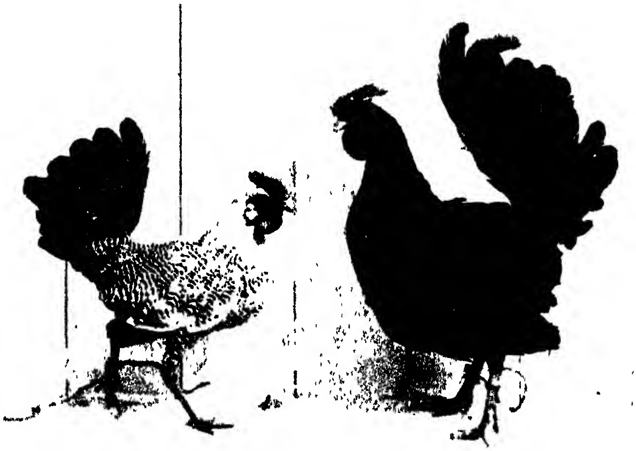

FIG. 2.—Small and large F_2 cockerells.

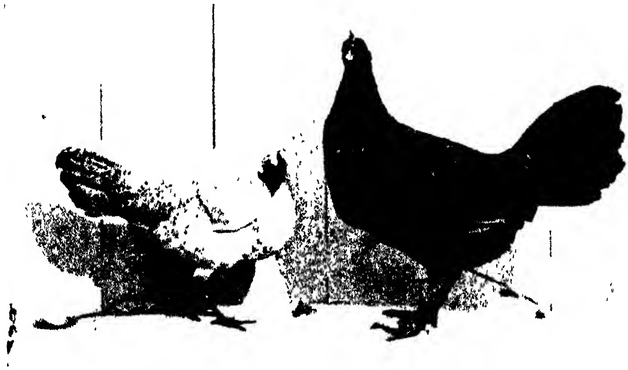

FIG. 3.—Small and large F_2 pullets.

pens of such F1 birds, an F2 generation of 239 birds was raised, viz., 113 cockerels and 126 pullets. In contrast to the uniformity of the F1 generation these F2 birds exhibited a wide range of variation. As shown graphically in Fig. 6, the weights of the cockerels varied from about 550 to 1,600 grammes, while those of the pullets were from 500 to 1,200. The majority of the birds in this generation were between the weights of the original parental breeds, but a few were larger than the Hamburgh, and a few were smaller than the Sebright (Plate 1, Fig. 2 and 3). Here we have an apparent case of blended inheritance, with fair uniformity in F1, and a wide range of variation in F2. Can such a case be interpreted in terms of the factorial theory? An interpretation is possible if we suppose that the Hamburgh and the Sebright differ in several factors, each of which affects the weight of the bird. The explanation of such cases was first given by Nilsson-Ehle, the well-known Swedish plant breeder, to account for the results of certain of his experiments with wheat and oats at Svalof. The closeness with which the theory fitted his results left little doubt of its being a true interpretation. The essential part of his idea is that a similar effect may be brought about by more than one factor, though such factors are independently transmitted in the usual way.

Let us suppose that there are several similar factors A, B, C, D, &c., which influence the weight of poultry. When a bird possesses none of these factors it will be the smallest type of bantam; when it contains A it will be rather larger; when it contains both A and B it will be larger again, and so on until the largest breed is reached, which must be supposed to contain a full collection of these factors. Again, let us suppose that when a bird is pure for one of these factors, *i.e.*, when it has received it from both parents, the effect on its weight is greater than when it has received it from one parent only. In other words we suppose that dominance is not complete, and that the Aa bird, for example, is not so heavy as the AA bird of otherwise similar constitution. And so also for the other weight factors, B, C, D, &c.

Now if we suppose that the Hamburgh contained three such factors, A, B and C, while the Sebright contained a different one, viz., D, we obtain a theoretical explanation which covers the observed facts:—

(1) The uniformity of the parental breeds for a markedly different average weight.

(2) The uniformity of the F1 birds in weight.

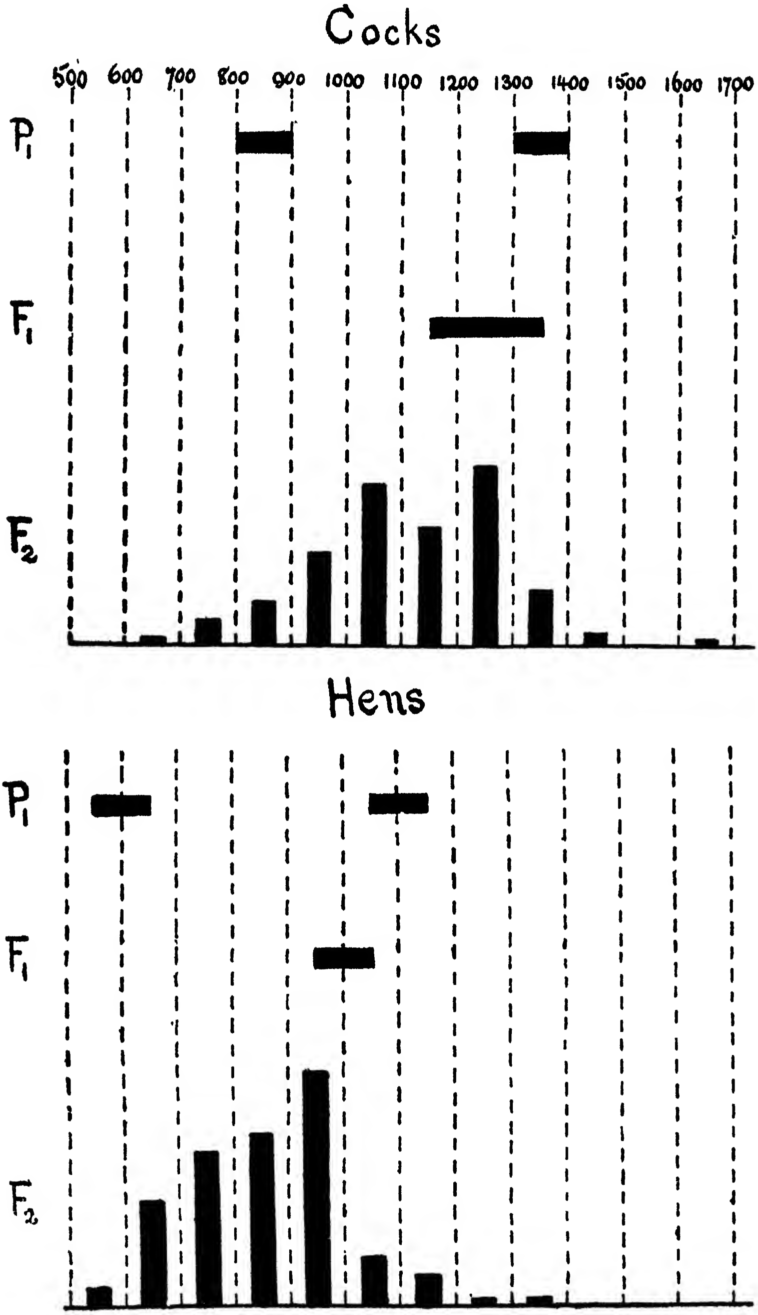

FIG. 6. Illustrating the inheritance of weight in the Hamburgh-Sebright cross. The figures at the top represent the weight in grammes. For further explanation see text.

(3) The approximation of the F1 birds to the weight of the larger parent.

(4) The great variation in weight shown by the F2 generation.

(5) The production in F2 of birds larger than the Hamburgh, and of others smaller than the Sebright.

For if the Hamburgh were *AABBCCdd*, and the Sebright *aabbccDD*, the F1 birds must all be *AaBbCcDd*. They will be uniform, and at the same time, since they contain a dose each of 4 factors, they will not on our hypothesis be much lighter than birds which, like the Hamburgh, contain a double dose of 3 factors. When, however, such birds are bred together they should give an F2 generation showing great variation, for such F1 birds should produce germ cells of 16 different kinds with respect to the four size factors involved, viz. :—

ABCD	*AbCD*	*aBCD*	*abCD*
ABCd	*AbCd*	*aBCd*	*abCd*
ABcD	*AbcD*	*aBcD*	*abcD*
ABcd	*Abcd*	*aBcd*	*abcd*

From the meeting of two such series of germ cells it is clear that all sorts of sizes will result; but the reader who wishes to follow out these possibilities in detail must be referred to the original paper.* It should, however, be noticed that such a combination as *AABBCCDD* will occur, in which a bird is pure for all 4 factors. Birds of this combination, as well as others, such as *AABBCCDd* or *AABBCcDD*, should be heavier than the Hamburgh. Again, we may have the combination *aabbccdd* in which none of the 4 factors are found. Such birds must be smaller than the Sebright.

The theory is in accordance with the series of facts to be explained that was set out on pp. 253 and 255. It can, however, be subjected to further test. The very large F2 birds, and the very small ones should, on the theory, breed true to size. Lack of opportunity prevented the testing of the biggest ones, but a pair of the smallest F2 birds (shown on Plate 1, Fig. 2 and 3) was mated together, and found to breed true to the unusually small size. Lastly, among the birds of intermediate size there should be some which are pure for 2 factors, *e.g.*, *AABBccdd*, which should breed true to a size intermediate between that of the Hamburgh and the Sebright. Recent tests have revealed the existence of such birds.

This series of experiments suggests that even so complicated

* "On Inheritance of Weight in Poultry," by R. C. Punnett and P. G. Bailey: *Journal of Genetics*, Vol. IV, 1914.

a character as that of weight, where inheritance is seemingly of a blended nature, can nevertheless be interpreted in terms of definite factors, each producing a definite effect. It is not of course suggested that weight is dependent solely upon such factors. Absolute uniformity, even where animals are of the same genetical constitution, cannot be expected. For no two animals can be treated exactly alike with respect to food and other conditions. Moreover, it is conceivable that other factors, influencing vigour as distinct from weight, may come into operation, and produce some effect upon weight itself.

The results are not without interest in connection with the problems of in-breeding and the effects of a cross. Close in-breeding is held by some to lead to deterioration in the matter of size, and there is certainly some foundation for this belief. Yet it is by no means certain that, sometimes at any rate, this deterioration is not due to the fact that the original material was impure in some of the size factors, and that one or more of these may have been eliminated by unconscious selection. Again, there is much evidence to suggest the view that first-cross animals frequently make unusually good growth, and exceed both parental strains in weight. By some this effect is referred to the increased vigour resulting from a cross. This, of course, is no explanation, so long as we cannot state precisely how this increased vigour is brought about. It may be that there are definite factors working for vigour, though at present this has not been experimentally proved. The poultry results force us to recognise that increased size in first crosses may be due to a cumulative effect of different size factors brought in by the two parental breeds.

The two strains *AABBccdd* and *aabbCCDD* would each be of intermediate size, and nearer in this respect to the Sebright than to the Hamburgh. First-cross birds betewen these two would be in constitution *AaBbCcDd*, *i.e* , of the same constitution as the F1 Hamburgh-Sebrights. They would be larger than either of the intermediate parental strains, but this increase would not be due to vigour incidental to a cross, but to the cumulative effect of the 4 factors *A*, *B*, *C*, *D*, of which two were brought into the cross by each parent. Moreover, such F1 birds might be expected to give a small proportion of progeny larger than themselves, and breeding true to this increase in size. Where a notable increase in size follows on a cross, it suggests that the breeds used contained different size factors; and if this were so it would be possible to establish a strain of increased size by working on the lines indicated by the factorial theory.

Suggestive as the poultry experiments are, we recognise that we are only at the beginning of this kind of enquiry. Some experiments of a similar nature with rabbits gave a different result.* A cross was made between the Polish, which is the smallest of the breeds of domesticated rabbits, and the Flemish, which is one of the largest. The Polish was used as the father of the F1 animals, which were intermediate, and fairly uniform in size (Fig. 7). From two pairs of such F1 animals an F2 generation was raised. Owing to lack of accommodation the total number of offspring reared was only 37. Nevertheless this F2 generation shows a remarkable feature in that the size of the F1 animals was not exceeded, although some were nearly as small as the Polish parent. The absence from the F2 generation of anything approaching the size of the Flemish is highly puzzling, and no explanation can at present be offered. The experiment is being repeated with the difference that the F1 animals have been bred from Polish doe × Flemish buck, instead of in the reverse way as before.

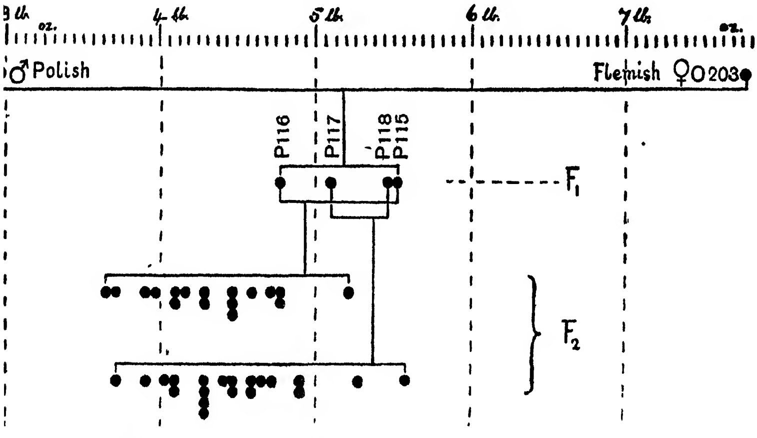

FIG. 7. Illustrating the inheritance of weight in a Polish × Flemish cross. Each individual is represented by a dot on the chart according to its weight in lb. and oz. Thus, the F_1 animal, P116 weighs 4 lb. 13 oz., and the P117 weighs 5 lb. 2 oz.

When planning investigations on these cases of apparently continuous variations it was felt desirable to choose another example of a different type. Accordingly a "pattern" case was selected in rabbits. Here, as in many of the domesticated animals, we encounter white markings, and the extent of these is very variable. We can in fact obtain a continuous series

* "Genetic Studies in Rabbits. 1.—On the Inheritance of Weight," by R. C. Punnett and the late P. G. Bailey: *Journal of Genetics*, Vol. VIII, 1918–19.

in the rabbit, ranging between the self-coloured animal with a touch of white on the nose or on a paw, and an animal completely white except for a touch of pigment round the eye and at the root of the tail (Plate 2, Fig. 3). Such a continuous series can in fact be bred in the F2 generation from a cross between a self-coloured animal and one of these almost white ones. The problem here again was to determine whether such an apparently continuous series could be expressed in terms of a few definite factors, or whether some other explanation had to be sought.

The case was of more than usual interest because Professor Castle, working at a similar case in rats, had put forward the view that the factor itself could be changed by "selection." Were this view upheld by experimental research, it is evident that we should have to give up the conception of the relative permanence of the factor which forms the basis of the factorial theory, and with it that hope of control over breeding operations which the definite and permanent factor signifies. The results of our experiments with rabbits did not bear out Professor Castle's view. We found that a comparatively simple interpretation on factorial lines would cover the facts.* Moreover, Professor Castle himself has recently given up his earlier view, and considers that an orthodox explanation, in terms of the factorial theory, is adequate. We have mentioned the case here because the idea that the factor can be influenced by "selection" is to be found in text-books that are widely read. It may serve to prevent misunderstanding if it is realised that the view is no longer supported by its originator.

As we have already stated, a cross between a self-coloured animal and a "White Dutch" gives F1 animals with a small but varying amount of white, and in F2 a full range from Self to White Dutch. In such a series, however, the gradual increase of the White occurs in a more or less orderly fashion. It begins with the tip of the nose or muzzle, the tips of the fore paws, and the "blaze"; it then invades the neck, shoulders and fore limbs; at a more advanced stage we reach the typical pattern of the Dutch rabbit (Plate 2, Fig. 1); later on the pigmented area round the eyes is reduced and the coloured area of the body becomes patched with white, giving rise to the "spotted Dutch" (Plate 2, Fig. 2); further reduction of the pigment eventually results in the White Dutch (Plate 2, Fig. 3).

* "The Genetics of the Dutch Rabbit—a Criticism," by R. C. Punnett: *Journal of Genetics*, Vol. IX, 1920.

FIG. 1.—Rabbit with Dutch pattern

FIG. 2.—Spotted Dutch rabbit

FIG. 3.—White Dutch rabbit.

A long series of experiments has shown us that 3 pattern-types corresponding to Dutch, spotted Dutch, and White Dutch can be got to breed approximately true. The more pigmented tends to be dominant to the less pigmented, but as a rule dominance is far from complete, so that various intermediate forms arise. Two pairs of factors *T-t* and *S-s* serve to interpret the range of forms between Dutch and White Dutch, Dutch being *TTSS*, Spotted Dutch *ttSS*, and White Dutch *ttss*.

The relation of all these to the more heavily pigmented grades is determined by another factor *P*; its presence represents much increased pigmentation. A single dose of *P* added to White Dutch transforms the animal into one with a pattern resembling the Dutch*; added to Spotted Dutch, it leads to a grade of pigmentation between Dutch and self-colour; added to Dutch, it results in an animal that is almost or quite self-coloured. Where the animal is *PP* the White area is further diminished, but the difference between *PP* and *Pp* animals has not yet been fully worked out.

The outstanding fact in connection with these patterns is that analysis of this continuous series, from self to almost white, has provided an interpretation in terms of the factorial theory; and that, too, in terms of but 3 factors.

* The *Ppttss* animal may be indistinguishable from the *ppTTSS* animal in appearance, but the two breed very differently.

HOP-"MOULD" AND ITS CONTROL.

II.

E. S. SALMON,
Mycologist to the South Eastern Agricultural College, Wye, Kent.

The first part of this article, published in the May issue of the JOURNAL, *contained a description of the Life-History of the Hop-" Mould " or Mildew. An account was given of the damage caused by " Mould " and the preventive measures to be taken against further attacks. The figure numbers quoted below refer to the illustrations in Part I.*

Indirect Methods.—It is of great importance for the hop-grower who experiences trouble with " mould " to pay attention to the following indirect methods of keeping the disease in check.

(1) *Destruction of " mouldy " Hops and Bines.*—The dangerous practice is sometimes followed, even by experienced hop-growers, of not picking the hops in a garden, or in a portion of it, which has become overrun by " mould." Such " mouldy " hops are often left on the poles or wirework for weeks after hop-picking-time (*Fig. 10*) for the linnets to shatter or for the wind to blow away. The result is that the " petals " of these over-ripe hops, bearing thousands of conceptacles with winter-spores (*Fig. 6*), become dispersed over the surface of the hop-garden, with the result that next season, given suitable weather conditions, severe attacks of " mould " occur again in the same garden. It is difficult to believe that any hop-grower becoming conversant with the life-history of the hop-mildew would tolerate this practice of sowing his hop-garden with the " seeds " (spores) of " mould." Even in the stress of hop-picking time, or at any rate immediately afterwards and before the unpicked hops have become shattered, the bine and the mouldy hops should be collected and burnt on the spot or carted off to make a bonfire on ground outside the hop-garden. Mouldy bines and hops should not be used as litter in yards where the dung is carted out to hop-gardens, nor as foundation for stacks except in places far removed from hop-gardens.

(2) *Early " Stripping " and Removal of " Runners."*—Where there is reason to fear an early outbreak of " mould " through

contamination of the soil, it is a wise precaution (in addition to early sulphuring) to strip off the lowermost leaves of the bine as early as it is safe to do so. The lower leaves of the bine serve as rungs of a ladder by which the "mould" ascends higher and higher towards the "burr." The lowermost leaves can be removed first and then in one or two operations at a later date the remaining leaves up to the "breast-wire" or about five feet; by this plan the growth of the young hop-plant does not receive too great a check.

The spread of the disease later in the season is frequently caused by the patches of "mould" present on the leaves of the "runners" growing out of the hills. The summer-spores from these patches are carried by the wind to the young hops where they give rise to "mould" or "red mould." The "runners" should be cut off with the hoe, or—a better practice—pulled out of the "hill." For the same reason any lateral shoots from the stripped bine should be removed.

(3) *Avoidance of "Housing-in."*—With certain systems of planting and training a great deal of bine is produced which gets matted together at the top, the "heads" extending more or less across the alleys—a condition known as "housed-in." In these circumstances there is a lack of ventilation and sunshine, and "mould" thrives. A system of training should be adopted to remedy these drawbacks.*

(4) *Balanced Manuring.*—Excess of nitrogenous manure induces late sappy growth of the hop-plant, which is then specially liable to be overrun by "mould." The necessary phosphatic and potash requirements of the crop must not be neglected.*

(5) *Provision of Male Hops.*—The planting of male hops (1 male hill to every 200 female hills) throughout the garden provides for the fertilisation of the "brush," and thus appreciably shortens the critical period when the hop is in "burr." The male hop must be of a variety which produces pollen-dust at the time when the particular variety with which it is planted is in "burr." The seeded portion of a hop-cone is less liable to "mould" than the seedless part—a fact first pointed out by Mr. A. Howard when at Wye College.†

(6) *Extirpation of "Wild Hops" in Hedges and Waste Places.*—Where so-called "wild hops" (usually originating as "cuts" thrown out from a hop-garden) exist in the neigh-

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* See *A. Amos*, Hop Cultivation (*Journ. Board of Agric.*), XVI, 881 (1910).

† See *Journ S.E. Agric. Coll.*, XIV, 214 (1905).

bourhood of a hop-garden, they constitute a source of danger. As soon as "mould" occurs on these "wild hops"—which is often very early in the season—myriads of summer-spores begin to stream from them on the air, and with favouring winds these reach adjacent hop-gardens. Since "wild hops" are not sulphured, the "mould" on them constitutes an unchecked source of infection throughout the season; the soil beneath them becomes plentifully contaminated with the conceptacles and their winter-spores, accounting for the early outbreaks of "mould" which so often occur year after year on "wild hops." A case of the sudden infection early in the season of a hop-garden at "Spring Grove," Wye, was investigated by Mr. Arthur Amos and the writer. The original source of the outbreak was tracked down to some "mouldy" "wild hops"' growing by the side of a ditch adjoining the hop-garden. Infection of the hop-garden from this point was proceeding through a wedge-shaped area of increasing dimensions. All "wild hops" in the vicinity of a garden should be grubbed up and destroyed.*

(7) *Varieties Resistant to "Mould."*—No exact testing, under the same conditions, of the comparative susceptibility to "mould" of the various commercial varieties of hops appears to have been made. The true "Golding" varieties are generally believed to be specially susceptible, while the old varieties "Grapes" and "Jones" have been stated to be more resistant. It is probable that under certain conditions all the commercial varieties of hops at present grown are liable to bad attacks of "mould." There is, however, one variety of hop which is absolutely immune to the attacks of "mould." This is a variety which possesses yellow-green leaves and is called the "Golden Hop"; it is sold by nurserymen as a garden plant, and does not appear to have any commercial value, since it is of weak growth and the hops are of poor brewing quality. Attempts are being made at Wye College to raise, by "cross-breeding" from the "Golden Hop," seedlings immune to "mould" and possessing the other desirable characteristics.

* The same species of mildew (*S. Humuli*) lives on the cultivated Strawberry and also on a number of common weeds (*e.g.*, Meadow-sweet, Field Lady's-mantle, Willow-herb, *Potentilla reptans*). Investigations have shown, however, that the forms of the mildew on all these plants are *specialised* and cannot pass, *e.g.*, from the hop-plant to the strawberry, or vice versâ. (See *E. S. Salmon* in Journ. Agric. Sci., II, 327 (1907). There is consequently no danger to the hop-garden from this mildew growing on any other plants—notwithstanding the statement to the contrary that is occasionally met with.

Spurious Measures often taken against " Mould."—(1) *Sulphur in the " Hill."*—In the mistaken belief that " mould " lives on the hop-plant in the " hill " during the winter months, applications of sulphur (usually in the form of " black sulphur," *sulphur vivum* or " green sulphur ") are given to the crown of the " hill " in early spring. Since the " spawn " of the hop-mildew does not occur in the " hill " or on the crown, it is mere waste of labour and material to apply sulphur (or any proprietary article) in this manner. Sulphur, and chemical substances generally, are not able to kill the winter-spores in the conceptacles, which may be lying on or in the soil around the " hill," owing to the thick, impervious " corky " walls of the conceptacle.

(2) *Use of Gypsum.*—Although gypsum (sulphate of lime) may under certain conditions act as a fertiliser when applied to the soil and so promote the general growth of the hop-plant, there is no scientific warrant for the belief held by some farmers and fostered by the sellers of gypsum, that the sulphur contained in gypsum is taken up by the plant which then becomes proof against " mould." This theory probably dates from the period when " mould " was generally believed to be due to the diseased condition of the sap of the hop-plant.

The practice of using gypsum in the " hill " (usually at the time of " dressing " or " cutting ") is, for the reasons given above (1), only a waste of labour and material.

NOTES ON MANURES FOR JUNE.

E. J. RUSSELL, D.Sc.,
Director, Rothamsted Experimental Station.

The Possible Use of Town Refuse as Manure.—The question has often been asked whether town refuse can safely be used as manure, and if so, what price the farmer would be justified in paying for it. Town refuse has the great advantage that it is available at all times and in considerable quantity, and on heavy land it has proved effective in lightening the soil and making it work more easily. It has, however, the great disadvantage that it may contain the germs of crop diseases, and this has become all the more serious since the spread of Wart Disease throughout various counties. Unfortunately no simple test is known to enable one to ascertain whether a bulk of town refuse is or is not free from the spores of wart disease.

Apart from this risk, however, there is a good deal to be said for its use. Its composition varies considerably as between different towns, though in any given town the variation may be less than might be expected. Thus, three separate samples from Sheffield have given the following results:—

Percentage of	*Sample 1.*	*Sample 2.*	*Sample 3.*
Moisture	2·84	2·89	2·77
Organic matter (loss on ignition)	28·6	34·2	37·5
Nitrogen (total)	·7	0·57	0·67
Equal to Ammonia	·86	0·70	0·81
Phosphoric Acid (as P_2O_5)	·77	0·49	0·45
Equal to Tri-basic Phosphate of Lime .	1·74	1·09	0·98
Potash (as K_2O)	·33	0·64	0·50
Lime (as Calcium Carbonate by calcimeter)	4·93	1·6	2·1

There is a satisfactory amount of organic matter and of nitrogen, and the lime, while not large in quantity, would help in lightening a heavy soil.

The Storage of Artificial Manures.—A correspondent has raised the question as to how long various artificial manures may be kept stored in a dry place without losing effectiveness. With the exception of superphosphate most artificial manures could be kept indefinitely if the conditions of storage were sufficiently good. In practical circumstances, however, the conditions are more or less defective, and trouble arises owing to the absorption of moisture.

Basic Slag is very little affected by storage, and can be kept almost indefinitely in a reasonably dry shed or store.

Sulphate of Ammonia is somewhat more easily affected by atmospheric moisture, especially if it comes from small gas works where it has not been well finished. The well-made neutral sulphate, however, is less affected. In any case the material is best stored in bags placed on planks or on a layer of peat rather than on the bare earth or brick floor. It may cake somewhat on storage, and should then be broken up with a wooden crusher.

Nitrate of Soda, Kainit and Sulphate of Potash.—These substances will keep indefinitely under dry conditions, such as the merchant's store; they may also be preserved for a long time in a well built shed on a farm. They undergo no inherent deterioration, but they may become lumpy through the action of moisture, and must then be crushed. There is no practical limit to the length of time the above fertilisers may be kept so long as the conditions are suitable.

Superphosphate is in a rather different category, and undergoes slow change on storage, which up to a certain point is advantageous. Well made samples in good condition have been stored for the necessary time by the makers; but prolonged storage may cause deterioration to set in. On the whole it is advisable to avoid the necessity of storing by careful calculation of the requirements and by using early in the following season any material that happens to be left over.

Nitrate of Lime cannot easily be stored once the package has been opened, as it is liable to absorb moisture in damp situations.

Ground Limestone can be stored indefinitely, either in bags or in bulk; but *lime* cannot be stored in bags, again because of its great power of absorbing moisture.

Nauru Phosphate.—Much interest is being taken in Nauru phosphate, and enquiries are being made by farmers and others as to its probable value. Samples are not yet to hand, but arrangements have been made at Rothamsted for a field test as soon as the material arrives.* Even if it proved unsuitable for direct application to the land, it might still be found valuable in the manufacture of superphosphate. It is stated to be very rich in phosphate, containing phosphoric acid equivalent to 85-86 per cent. of tricalcic phosphate, with occasional patches running as high as 87-88 per cent.; there is said to be no low grade, and that it would be impossible to ship a cargo running below 80 per cent, without deliberate

* Experiments are already being undertaken elsewhere.

adulteration. The original estimate of the amount on the island was 50,000,000 tons, but this figure has now been amplified and is put at 75,000,000 tons. The composition is better than that of African phosphates, which contain phosphoric acid equivalent to about 60 per cent. of tricalcic phosphate. It remains to be seen, however, whether it can compete in the matter of price and effectiveness with these phosphates in view of the long sea voyage: Nauru lies nearly 2,000 miles to the N.E. of Australia, half-way between the Solomon Islands and the Marshall Islands, and freight is bound to be an important consideration.

Potash Content of French Kainit.—The company responsible for the supply of French potash fertilisers informs us that the grade of Sylvinite known as French Kainit is sold with a minimum guarantee of 14 per cent. of potash (K_2O), and that its composition actually approximates to 14-16 per cent. This correction is made because a somewhat lower figure was mentioned in an earlier issue of these notes.

NOTES ON FEEDING STUFFS FOR JUNE.

E. T. HALNAN, M.A.,
Ministry of Agriculture and Fisheries.

Hints on the Storage of Cake.—On most farms the stocks of cake bought for winter use will be almost exhausted, and it may therefore be opportune to enumerate the chief points to observe in order to keep cakes in good condition. The corner of the shed used as a cake store should be dry and well ventilated, and if possible should be provided with a cement floor. In buying cakes the purchaser should see that the cakes are dry and in clean wholesome condition. It is generally a good investment to have cakes analysed. Cakes that are at all mouldy or damp should be avoided at all costs. In stacking the cakes, care should be taken to stack them so that the air can circulate freely through the pile, in order to avoid the possibility of damping and overheating. Cakes that are properly stored in a dry, well ventilated shed, keep sweet and wholesome for a long time, and the little extra trouble and expense in providing a suitable shed for well stacking the cakes is more than repaid by the absence of feeding troubles.

Oats and Oat By-products.—Oats are familiar to all farmers as a stock feed and are especially valued for young and growing stock. Oats form a palatable feed for horses, cows, cattle and sheep. For horses, the oats are fed whole or clipped; for cows and cattle and sheep, the oats are roughly crushed. With the hulls removed, and finely ground, oats form an excellent food for young calves and growing pigs. For poultry, the oats are ground whole to a fine impalpable meal, which under the name of Sussex ground oats is especially valued for fattening poultry.

In the manufacture of oatmeal for human consumption several by-products arise which are, perhaps, less familiar to the stock feeder. The outside hull is first removed. The hulls resemble chaff in composition, and have a very low feeding value, but can be regarded as a suitable diluent for concentrated feeding stuffs. The hulls, called "sids" in Scotland, form from 20-40 per cent. by weight of the whole grain, and hundreds of tons are produced annually and find a ready market. In Scotland it is the usual practice for the miller

NAME.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	42/-	400	11 15	1 6	10 9	71	2/11	1·56
„ Canadian „ -	40/-	400	11 4	1 6	9 18	71	2/9	1·47
Oats, English „ -	44/-	336	14 13	1 9	13 4	59·5	4/5	2·37
„ Foreign „ -	32/-	320	11 4	1 9	9 15	59·5	3/3	1·74
Maize, Argentine -	52/6	480	12 5	1 5	11 0	81	2/9	1·47
Beans, English spring -	70/-	532	14 15	3 1	11 14	66	3/6	1·87
„ „ winter -	55/-	532	11 12	3 1	8 11	66	2/7	1·38
„ Rangoon - -	8/6	112	8 10	3 1	5 9	66	1/8	0·89
Peas, English blue -	58/-	504	12 18	2 13	10 5	69	3/-	1·61
„ „ dun -	70/-	504	15 11	2 13	12 18	69	3/9	2·01
„ „ maple -	72/-	504	16 0	2 13	13 7	69	3/10	2·05
„ Japanese* - -	112/6	504	25 0	2 13	22 7	69	6/6	3·48
Buckwheat - - -	64/-	392	18 6	1 9	[illegible] 17	53	6/4	3·39
Rye, English - -	55/3	480	12 18	1 8	11 10	72	3/2	1·70
Millers' offals—Bran -	—	—	6 15	2 10	4 5	45	1/11	1·03
„ „ Coarse middlings	—	—	9 5	2 10	6 15	64	2/1	1·12
Barley meal - - -	—	—	15 0	1 6	13 14	71	3/10	2·05
Maize „ - - -	—	—	10 17	1 5	9 12	81	2/4	1·25
Fish „ - - -	—	—	21 0	7 12	13 8	53	5/1	2·72
Linseed Cake, English -	—	—	16 7	3 12	12 15	74	3/5	1·83
Cotton seed „ „ -	—	—	12 10	3 5	9 5	42	4/5	2·37
„ „ decorticated	—	—	15 0	5 6	9 14	71	2/9	1·47
„ Meal decorticated	—	—	12 15	5 6	7 9	71	2/1	1·12
Coconut cake - -	—	—	10 0	3 0	7 0	79	1/9	0·94
Groundnut cake - -	—	—	9 0	3 9	5 11	57	1/11	1·03
„ „ decorticated	—	—	12 0	5 5	6 15	73	1/10	0·98
Palm kernel cake - -	—	—	6 5	2 1	4 4	75	1/1	0·58
Brewers' grains, dried, ale	—	—	6 17	2 7	4 10	49	1/10	0·98
„ „ wet „ -	—	—	1 7	0 12	0 15	15	1/-	0·54
Distillers' „ dry -	—	—	11 0	2 16	8 4	57	2/11	1·56
Malt culms - - -	—	—	7 0	3 6	3 14	43	1/9	0·94
Potatoes† - - -	—	—	2 17	0 8	2 9	18	2/9	1·47
Swedes† - - -	—	—	1 4	0 5	0 19	7	2/9	1·47
Mangolds† - - -	—	—	1 3	0 6	0 17	6	2/9	1·47
Vetch and oat silage† -	—	—	2 13	0 15	1 18	14	2/9	1·47

* Price at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

to send the " sids " back to the farmers who sent in the oats for milling.

After the hulls have been removed, the resultant kernel is further treated to remove the tuft of hairs present at the top, and these hairs form the product called " oat dust." This oat dust forms a light fluffy felted mass, contains a considerable proportion of protein and fat, and owing to its nature is usually sold mixed with other feeding stuffs.

In further treatment the outside skins of the kernels are partially or wholly removed, and this product forms the oat bran, middlings, or shorts. Oat bran resembles wheat bran in composition and feeding value, but contains more fat.

The appended table of chemical analyses taken from Henry's Feeds and Feeding will give the reader an idea of the comparative values of the oat and its by-products.

	Water.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Ash.
Oats ...	9·2	12·4	10·9	59·6	4·4	3·5
Oat bran ...	6·4	12·2	18·3	52·3	4·7	6·1
Oat dust ...	6·6	12·6	18·7	49·9	5·2	7·0
Oat hulls ...	6·8	4·0	29·2	52·3	1·7	6·0

Notes on Table of Prices.—Palm kernel cake and wet brewers' grains form two very cheap feeding stuffs. There is little doubt that the cheapness of palm kernel cake is associated with the fact that it is a difficult cake to get the stock to eat *at first*. The golden rule with palm kernel cake is to introduce it very gradually into the feed and to keep the troughs scrupulously clean.

AGRICULTURE ABROAD.

AGRICULTURAL SCHOOLS IN ALBERTA—WHEAT GROWING IN CANADA.

The following note has been communicated by Mr. J. McCaig, Editor of Publications, Department of Agriculture, Alberta:—

System of Middle Agricultural Schools in Alberta.

The Province of Alberta, Canada, is becoming distinguished for its work in agricultural education, chiefly through the influence and work of the Hon. Duncan Marshall, present Minister of Agriculture for the Province. Mr. Marshall is a frequent visitor to the Mother Country and may be known to a good many readers of this *Journal*. In company with two other Canadian breeders he recently purchased a shipment of Shorthorns and Shropshires for his own farm.

Contrary to common practice, the Alberta system of agricultural education begins with a strong understructure rather than a heavy top, as represented by an agricultural college. All the provinces of Canada, in fact, are active in utilising a good body of agricultural material in connection with the elementary schools. This body is commonly referred to as "educational agriculture" rather than "material for agricultural education." A good deal has been accomplished in this elementary work in Alberta.

Both Boys and Girls.—Mr. Marshall's efforts relate specifically to the farm boys and girls after they have passed the elementary school age. The agricultural schools are administered by the Department of Agriculture, not by the Department of Education, and this gives them perhaps a closer touch with practice and application than they could possibly have as part of the general scholastic system. The schools are not integrated with the general educational system, but the work done in the agricultural schools, if students have sufficient general training for matriculation, counts in their university course at the college of agriculture. The outstanding service of the schools is that they give direct training to boys and girls who intend to go back to the farm. At present there are six of these schools in the Province, one-half of them having been opened in the autumn of 1920. It is expected that they will train upwards of one thousand boys and girls during the year. One of the schools during the last two years has done good work in training returned soldiers. The Minister has expressed his intention of making provision at these schools for special courses for British boys

and girls who need to be taught something about western agriculture before going on the land. These would probably be summer courses and would include a combination of study and farm work.

Free Courses.—Pupils must be sixteen years of age: there are no academic restrictions and no fees for tuition. The course extends over two years and sessions are limited to the period between October and April. Courses for boys, and for girls likewise if they wish to take them, include field husbandry, animal husbandry, dairying, shopwork and machinery, horticulture, poultry keeping, farm management, elementary farm economics, English, and farm mathematics. The sciences underlying these subjects are part of instruction so far as they relate directly to practice. The schools have a number of improving organisations such as athletic, musical and literary clubs.

Classes for girls include cooking, sewing, nursing, household management, accounting, dairying, poultry keeping and horticulture. They have instruction in the direct sciences such as bacteriology, chemistry, physics, &c., relating to practice. They also have English and mathematics and share in the benefit from the organisations for improvement and recreation. There are about six or seven teachers on the staff of each school.

Institutional Farms.—Connected with each school is an institutional farm called a demonstration farm. It is generally of a good size, consisting of not less than 320 acres, of which thirty acres are devoted to experimental work. The rest of the land is run like an ordinary farm with a manager and hired men, but it is under the direction of the head of the school for the purpose of ensuring that it shall exemplify farm practice of a high grade, based on the findings of the school. A good deal of attention is devoted to establishing conserving rotations, but this is not easy on parts of the prairie where grain growing is the chief business. The farms also serve for the raising of good seed and live stock, which are distributed to farmers at reasonable prices.

Wheat Growing in Canada.

FURTHER interesting particulars of the efforts made to improve the crop and increase the acreage of wheat in Canada are given in *The Agricultural Gazette for Canada* for May last. The April issue of this JOURNAL contained some information regarding the work of the Federal Government, assisted by private individuals who specialised in wheat growing. The following

gives an outline of the important part performed by the Provincial Departments of Agriculture during the War period and after. Three wheat growing Provinces are taken, which will suffice to show the trend of the great efforts which were carried on throughout the Dominion.

New Brunswick.—In 1917 and 1918 larger quantities of seed than ever before were imported, and correspondingly larger crops were harvested. In 1917, the acreage sown to wheat was about 15,000 acres; in 1918 it had trebled. The Provincial Government gave financial assistance in the erection of roller process mills, of which there are now 34 in the Province. Although a humid climate is generally unfavourable to wheat growing, large yields of excellent quality were recorded. Last season, in Kent County, a yield of 225 bushels of the White Fife variety was harvested from four acres—an average of 56 bushels per acre.

Ontario.—One million acres is the usual area sown to wheat in Ontario, which is well adapted for the production of high-yielding varieties of white winter wheat. In 1917 many car loads of Marquis spring wheat were imported from New York State for seed. Experiments in the testing and selection of seeds are made at the Ontario Agricultural College, and the results are published in bulletins, circulars and newspaper articles. Dawson's Golden Chaff is the most extensively grown variety of winter wheat in Ontario. Originating in the Province thirty-nine years ago, it produces a very stiff straw of medium length; it has beardless heads with red chaff and white grain, and is a heavy yielder, but the grain is rather soft. With the object of originating better varieties, crosses have been made at the College between high-quality varieties. One of these, Dawson's Golden Chaff, crossed with Bulgarian, has furnished a new variety called O.A.C. No. 104, which has given excellent results throughout Ontario. Several varieties of winter wheat are distributed each year for co-operative experiments.

Manitoba.—Wheat improvement in this Province commenced at the Manitoba Agricultural College in 1916; it is therefore too soon to expect striking results. The objects are twofold: (1) to obtain strains of wheat that will retain the high milling qualities of Marquis and Red Fife and will also yield well under the varied conditions prevailing in the Province; (2) to propagate pure lines selections and so become a source of elite stock seed. Introductions have been made from Denmark,

Sweden, New Zealand, Australia and the United States, and promising strains have already been secured, and these will be tested out. While many of them will probably not be of sufficient merit to be grown on the farms, they will be of great value for breeding. In 1916, about 250 selections were made from common varieties. Of these, one from Red Fife and two from Marquis have shown superior qualities and are being propagated. Pure line strains of approved varieties will be increased on the College farm; the seed will be sold by the Field Husbandry Department to seed growers and the provincial demonstration farms, and the crop inspected in the field by a representative of the Department. When thrashed, it will be re-purchased by the Department at a stated premium over market wheat and will then be cleaned and sold to one or two growers in each agricultural society. The grain will be again inspected in the field, and the seed cleaned through one of the local cleaning plants and sold to farmers in that locality through the Agricultural Society. Under this scheme, superior seed will be available in every part of the Province in less than five years. The activities of the Agricultural Societies include ploughing matches, standing field crop competitions, and seed grain fairs.

THE following note has been communicated by Mr. W. A. Watts, Bryn, St. Asaph, N. Wales:—

Egg Collecting and Mat Making in Anglesey.

Egg Collecting.—Among the enterprises fostered by the Anglesey Branch of the Welsh Industries Association is an egg-collecting depot. The depot building was erected by the L. & N.W. Railway Company at Llanfair P.G. station. Beginning on a small scale, the scheme developed steadily year by year until, in 1920, the turnover reached nearly £86,000, while the number of eggs collected amounted to over two and a quarter millions. During the busy season, as many as 95,000 eggs a week are collected by the Society's four motor vans which tour the island and parts of Carnarvonshire, collecting from each member at least once a week. At the depot the eggs are carefully tested and graded by girls who, after long practice, have become experts in this work, and so thoroughly is the work done that Anglesey eggs have gained a high reputation, the demand at the best prices being always in excess of the supply. Run on co-operative lines the Anglesey Egg Collecting Depot, Limited, as the Society is styled, now has 650 members. Everything possible is done to encourage egg production: for six months of last year an expert engaged by the Society travelled round the whole district, visiting and giving advice to all the members.

Mat Making.—Another instance of a successful rural enterprise is that of mat making, conducted at Newborough. The ancient industry of mat making has been carried on at Newborough, a village close to the sea, for many years, the material used being Marram grass,* which grows on the sand dunes near by. The grass is cut in August or September and is stacked ready for use. Originally made for thatching stacks, few mats were sent out of the neighbourhood and buyers could obtain them only from local tradesmen, who received them from the actual makers in return for groceries, bread and other necessaries, not for cash. The rope made from the same material, however, found a wider market, being used in railway works and slate quarries.

During the War the industry was taken in hand by the Anglesey Branch of the Welsh Industries Association. It was believed that when the importation of Archangel mats ceased, there was a possibility of placing the Newborough product on the market and so establishing a new trade for horticultural purposes. Several of the leading nurserymen commendably agreed to try

* See this *Journal*, February, 1914, p. 996, and February, 1913, p. 935.

the mats and so encourage a home industry. They found the mats successful, and ordered large quantities; the demand from other directions increased rapidly and the makers realised higher prices.

For thatching purposes, the mats were originally made 15 ft. by 4 ft., but for horticultural purposes they are chiefly made 12 ft. by 4 ft. They are almost frost proof and very durable, and will last five years or more. In 1918, a meeting of members, who, it should be noted are all women, was held, when it was decided to form and register a Co-operative Society, the Newborough Mat Makers' Association, affiliated to the Agricultural Organisation Society. The shares are of the value of 2s. 6d. each, fully paid.

The Suppression of Weeds: National Necessity.

THE suppression of weeds, always an important consideration to farmers, is specially urgent at the persent time. During the War, shortage of labour and the increase of the area under corn and root crops led to the rapid fouling of land formerly clean, and the result of these conditions is still apparent. Farmers are urged, therefore, to remit no effort in combating weeds, which cause so serious a reduction in crop yields. If existing arable land is to be kept in a high state of cultivation, it is essential to sow pure seed of high germinating power and to keep weeds down. Suppression of weeds is also a main factor in the improvement of pasture.

Weeds are injurious in many ways. They absorb moisture and plant food which should go to benefit the crops; they crowd the good growths, checking the free circulation of air; they deprive the sprouting seed of necessary sunlight; they hamper harvesting operations and interfere with the singling of roots. Further, these enemies of good husbandry harbour insect pests, reduce the value both of hay and of cereal samples and, where they are parasitic or semi-parasitic, obtain their food by direct robbery of the crops they infest. Nor does this exhaust all counts of the indictment. Some weeds, such as garlic, taint the milk of cows. Drains may be stopped by the underground spread of weed-stems and roots.

The advantages of thorough weeding have been proved by experiment. It has been shown that a properly weeded area of arable land may produce double the crop possible on neglected ground. Land hoed twice produced 37½ tons of mangolds per

acre but only 16¼ tons when weeding after singling was omitted. During the War weeds and the effort to get rid of them cost British farmers millions of pounds.

The war against weeds can be waged successfully only by those who understand the ways in which these pests gain access to the farm land and spread among cultivated crops. Many weed seeds, such as the thistle and dandelion, are carried considerable distances by the wind. Weeds are conveyed also by farmyard manure. They are found in screenings from threshing and winnowing machines, and the sweepings of barns and haylofts. They are found in manure from cattle fed on inferior hay. Well-rotted farmyard manure will contain fewer germinable weed seeds than fresh manure, and is therefore less liable to introduce weeds to clean fields. A potent means of conveyance is the use of poor seed. The presence of 1 per cent. of dock seed in a mixture of grass and clover means 10 or more dock seeds per square acre all over the field on which such a sample is sown at the ordinary rate for leys. Broken pieces of root also serve to spread trouble, and machines, such as self-binders and travelling thrashers, are often responsible for a wide distribution of weed seeds which are carried on the machines and also in the mud picked up by the wheels. The fruits and seeds of certain weeds such as burdock, corn-buttercup, wild carrot and cleavers fasten on the wool and hair of animals and the clothes of human beings and are thus carried considerable distances. Birds also are effective agents in distributing weed seeds.

The most obvious means of suppressing weeds is to prevent seeding. When it is recognised that mature charlock plants produce from 1,000 to 4,000 seeds, a moderate sized poppy 10,000 to 15,000, and large plants often 50,000 seeds, the force of the adage "one year's seeding is 7 years' weeding" becomes manifest. Further, as many weeds produce seeds which do not all germinate at the same time the mischief is greater than appears at first sight, for some may lie dormant in the soil and spring up after an interval of several years. To destroy weeds of this type it is advantageous to introduce into the rotation root and other crops which promote a thorough cleaning. Seeding of weeds in hedgerows, on roadsides, waste places and round farm buildings should be prevented as far as possible. Another important precaution is to avoid the use of imperfectly cleaned seed. The Ministry desires to impress upon farmers the great importance of ensuring that there shall be no failure of crops due to the sowing of poor seed.

Care should be taken to burn such refuse as proceeds from screenings, sweepings of haylofts and the like. Deep ploughing is another very successful method of repression, as many seeds and weeds rot when deeply buried. Harrow cultivation and the preparation of a good tilth before sowing will encourage weed seeds to germinate and the seedlings may be destroyed by further stirring of the soil. Many annual and biennial weeds will thus be cleared away. The use of the horse-hoe is very serviceable for cleaning spring-sown corn. Land on which weeds are plentiful should be disced or lightly scarified immediately after harvest. This will encourage annuals to sprout and the young weeds can be ploughed in afterwards. Hand pulling, digging with fork or spade and the total removal of weeds are efficient but expensive methods, and should be resorted to only when other plans have failed or are inapplicable. In every case the weeds collected should be burned. Fallowing, either bastard or bare, as a cleaning process, is largely practised in heavy soils with good results. On sour, damp soil, liming and draining will prove effective. Sheep's sorrel, corn marigold, spurrey and some other weeds can be checked to a considerable extent by a dressing of lime. Heavy smother crops may also effect a good reduction; on foul land such crops may prove very valuable before roots. Suitable crops for the purpose are mixtures of vetches or peas with oats, or rye with a few beans. In every system of arable farming the growth of a root crop is the most important means of suppressing weeds of all kinds. As a rule, the state of a farmer's root crop towards the end of summer is a good indication of the level of his farming.

No one need unknowingly purchase seeds badly contaminated with such injurious weed seeds as Docks or Sorrels, the Cranes-bills, Wild Carrot, Yorkshire fog, or Soft Brome grass, as under the Testing of Seeds Order, 1918, the seller is bound to disclose the presence of these in a parcel of seed if they are present to the extent of more than 1 per cent.

It may also be added that Section 4 (10) of the Agriculture Act, 1920, enables notices to be served on the occupier of any land on which injurious weeds are growing, requiring the occupier to destroy such weeds. Regulations have been laid before Parliament and will be made shortly, enabling these powers to be exercised in respect of land infested with Thistles, Docks or Ragwort.

The Frit Fly: A Danger to Cereal Crops.

THE Frit Fly is a serious menace to cereal crops throughout the whole of the Northern and Central Europe and the British Isles. In England the severity of the attack varies from year to year. In bad years the whole of the country, except perhaps the Fen Districts, is seriously affected; in other years local damage may occur anywhere. The greatest damage is done to spring-sown oats, but winter oats, winter and spring-sown wheat, barley and rye have been attacked and possibly have suffered more injury than is usually recognised.

The damage to spring-sown oats becomes apparent in late spring and early summer. The main shoot and possibly the first formed tillers cease to grow, the young central shoot dies, but the outer sheathing leaves may remain green. Further tillers form, but perhaps too late to produce ears. A fresh attack occurs in July; in this case the ears are damaged and while the larvæ may be found living on the young soft corn, which they either destroy or so damage as to render it worthless. It is true that this attack is often overlooked, as the effect on the field is not very apparent. The chief indication of the damage is the very light weight of the crop on thrashing. Should the grain be threshed at harvest time, the cause of the light weight may become further apparent from the great number of flies that will issue from the store. A crop may be ruined by the first and at least badly damaged by the second attack.

Frit and eel-worm may occur together, but a frit attack is often confused with that of the eel-worm and recorded under that name. Perhaps the best superficial characteristics by which an eel-worm attack may be determined are the swollen base of the plant and the absence of the white frit grub. Growers, however, are advised not to rely upon their own diagnosis, but to consult an expert. The researches of Petherbridge at Cambridge seem to show that the attack on winter wheat occurs almost solely when this crop follows late ploughed leys—notably of rye grass. This attack may be avoided by bastard fallowing.

Frit-like larvæ—whether the pest of the cereal or of some allied species is not clear—have been found on annual meadow grass, smooth meadow grass, couch grass, perennial rye grass, Italian rye grass, Timothy, meadow foxtail, wood millet, meadow fescue, yellow oat grass, common oat grass, and its

variety onion couch or knot grass. It is therefore probable that on most farms there must always be a large natural reservoir of flies.

In the late summer or autumn the female Frit fly lays her eggs on the leaves or stems of grass, and possibly, though there is little evidence of this, on winter wheat and winter oats. The eggs hatch quickly and the young larvæ make their way to the centre of the shoot, which they destroy. As a rule, throughout the winter, the minute white grub may be found, close down to the base of the shoot; it is about $\frac{1}{8}$th inch in length and without legs. In the spring the grub changes to a pupa inside a reddish brown pupa-case or puparium, either at the point where it has been feeding or at various heights under the outer leaf sheaths. The date of emergence of the frit fly pupa is governed largely by weather conditions. Usually it occurs in England from the middle of April to about the middle of May. The date of the first appearance or at least the period of maximum emergence of the spring brood, is of the utmost importance to farmers, for if the young spring corn is sufficiently advanced in growth at this date, proof exists that it will be immune to attack, at least for all practical purposes. The adult fly is of a brightly shining black, except for the yellowish or brownish legs, and has a characteristic short hopping flight. The female flies, appearing in April or May, lay their eggs on the spring-sown oats and the resulting larvæ pass through similar transformations, doing the same injury to the plant as the previous generation, but the time spent in undergoing these transformations is shorter, lasting from six to eight weeks. During July the flies of the second generation appear, ready to lay their eggs in the ears of the young corn. The third generation appears during August and September, the females laying their eggs on grasses and occasionally perhaps on autumn-sown corn.

To control the pest on oats, the object is to get the young oat plant forward as rapidly as possible. Growth may be accelerated by the use of stimulating manures, which should be readily available. Nitrogenous manures are of most importance. As far as frit fly is concerned, the manure is needed chiefly during the early stages of growth and may even be harmful if used too freely, as it tends to cause lodging. For this reason, therefore, moderate dressings, say $\frac{3}{4}$ to 1 cwt. of sulphate of ammonia along with 2 cwt. of superphosphate per acre, should be applied. Once an attack is far advanced, little can be done in the way of

control: a top-dressing of sulphate of ammonia does not appear to be satisfactory, but nitrate of soda is said to be effective if applied early enough. Winter oats are seldom damaged, and records show that this cereal, sown in the spring, will escape infestation, possibly because it tillers more freely. In any case it must be sown quite early if a crop is to be obtained.

Experiments made to test the resistance of different varieties of oats to frit fly attack, show that there are marked differences but that they are not the same in all parts of the country. In general the more modern varieties do better than the older "Abundance" types, owing to the greater speed with which they throw up the central shoot. On the other hand the old straw-producing oats such as Potato and Sandy, owing to their powers of tillering, recover well from the first attack, though it would seem that they tend to suffer more from the grain attack. Probably the variety best suited to the district will in most cases be found to suffer least from attack, owing to a rapid and healthy growth in the young stages. In this connection the importance of a good seed bed in the case of oats must not be forgotten. Rough, cloddy land tends to retard growth, and in consequence makes the crop very susceptible to frit fly.

Rabies.—Only one outbreak of Rabies has occurred in any part of Great Britain since the last issue of the *Journal*, on the 10th May at Southampton.

Glamorgan District.—All restrictions in connection with the outbreak at Cowbridge on the 11th September last were removed as from the 1st May, 1921.

Metropolitan District.—The position in this District remains unchanged.

Berkshire District.—The District subject to restrictions on account of the outbreaks at Reading and in the High Wycombe District has now been contracted by the exclusion of portions of Hertfordshire, Middlesex, Surrey and Berkshire on the eastern side of the District, and by the exclusion of the District around and to the north of Newbury, on the western side. This modification took effect on the 1st May.

Wilts, Dorset and Hampshire.—A considerable reduction of this area was also made as from the 1st May. With the exception of a small area in the Lambourn District to the south-east of Swindon, which remains under the Muzzling Order, the whole of the northern part of the existing Scheduled District, comprising those portions of Somerset, Wilts, Hampshire and Berkshire which lie approximately north of a line through the towns of Andover, Warminster and Shepton Mallet has been released. At the same time, the requirement of leading has been withdrawn from the Southampton and District Inner Controlled Area.

Foot-and-Mouth Disease.—On the 22nd April a further outbreak of Foot-and-Mouth Disease occurred in Irish animals landed at the Birkenhead Irish Animals Landing Place for slaughter therein ; but no extension of disease has occurred therefrom. The trade in Irish animals was in consequence temporarily suspended.

Yorkshire.—On the 3rd May existence of disease was confirmed in animals at Thurstonland, near Huddersfield. As a result of this outbreak the usual order was issued by the Ministry prohibiting the movement of animals into, out of, along, over, or across any highway or thoroughfare within an area having a radius of approximately 15 miles from the infected premises.

Derbyshire, Norfolk, and Cheshire.—There have been no further developments in connection with the outbreaks confirmed on the 7th March in Derbyshire, the 10th April in Norfolk, and the 16th April in Cheshire. In all three cases the restrictions have been considerably modified and are now applicable only to small areas immediately surrounding the infected premises.

World Supplies of Wheat and Rye.—The Ministry has received the following information from the International Agricultural Institute at Rome :—

It is estimated that the available world supplies of wheat and rye will be sufficient to meet requirements until the next harvest, and to leave a balance on 1st August of at least 6½ million quarters.

Inspection of Tithe Apportionments, &c.—The Minister of Agriculture and Fisheries desires to give notice that as from Tuesday, the 17th May, 1921, the fee for the inspection of Tithe Apportionments, Tithe Maps, &c., at this Office will be increased to 2s. 6d. for each document inspected on each day's attendance.

Past Issues of the *Journal* and *Journal* Supplements.—Readers of this *Journal* whose sets are incomplete may be glad to take advantage of the fact that the Ministry is now in a position to supply copies of most

past issues of the *Journal*, some of which have not recently been available. The copies are in good condition and comprise all issues *except the following* :—

Vol. I, Nos. 1 and 2.	Vol. VI, Nos. 1, 2, 4.
„ II, „ 4.	„ VII, „ 1, 4.
„ III, „ 2.	„ VIII, „ 1, 3.
„ IV, „ 1, 2, 3, 4.	„ IX, „ 3.
„ V, „ 2, 3.	

All who desire to complete their sets are invited to apply for the copies they require, which will be sold at the published price, as follows :—

Vols. I to IV	6d. per single copy	(quarterly)	Post free.
„ V to X	1s. „ „ „	„	
„ XI to XXVI (No. 9) ...	4d. „ „ „	(monthly)	
„ XXVI (No. 10) to XXVII	6d. „ „ „	„	

The number of copies of certain issues is very limited.

Copies of *Journal* Supplements are also available, excepting Nos. 4 and 8. A list of these, together with prices, can be obtained on application.

Bound Volumes of Leaflets.—The three Bound Volumes of Leaflets at present issued by the Ministry have been priced at 1s. 6d. per volume. It has recently been decided that the volumes must in future be sold at a price which will approximate more closely to the cost of production, and the Ministry is therefore reluctantly compelled to increase the price to 2s. 6d. per volume, or 6s. the set of three volumes. The volumes can be obtained from the Secretary, Ministry of Agriculture, 10, Whitehall Place, S.W.1.

Guides to Small Holders :—The Ministry still has a good stock of the pamphlets entitled "Guides to Small Holders," which were published in 1919 for distribution chiefly among ex-Service men intending to settle on the land. These guides, which deal with subjects of great interest to farmers, small holders, market gardeners and allotment holders, were formerly priced 2d. each, but were issued free to ex-Service men. They may in future be obtained by all applicants, free of charge and post free. Applications should be addressed to the Secretary, Ministry of Agriculture, 10, Whitehall Place, S.W.1. The following is a list of the Guides available :—

No. 1. Pig Keeping.
2. Dairy Farming under Smallholding Conditions.
3. Co-operation for Small Producers.
4. The Smallholder's Horse.
5. Farm Crops.
6. Soils and Manures.
7. Fruit Growing on Small Holdings in England and Wales.
8. The Dairy Cow and Milk Selling.
9. Potato Growing on Small Holdings.
10. Market Garden Crops on Small Holdings.
11. Poultry Keeping for Small Holders.

Research Scholarships in Agricultural and Veterinary Science :—The Ministry invites applications for Research Scholarships in Agricultural and Veterinary Science.

Applicants for these Scholarships must be nominated by a Professor or Lecturer of a University or College. Nominations must be received not later than 15th July next, and must be made on the prescribed form to be obtained from the Secretary, Ministry of Agriculture, 4, Whitehall Place, S.W.1.

The Scholarships are tenable for two years and are of the value of £200 per annum. The number to be awarded in the present year will depend upon the qualifications of applicants, and will in any case not exceed five.

The Agricultural Scholarships are open to graduates with honours in Science of a British University who give evidence of high proficiency in subjects having a direct bearing on agriculture. The Veterinary Scholarships are open to students who have secured the diploma of the Royal College of Veterinary Surgeons.

Leaflets issued by the Ministry.—Since the date of the list given on page 1178 of the March issue of this *Journal* three new leaflets have been issued and circulated :—

No. 362.—The Selection, Storage, and Treatment of Seed Potatoes.
" 365.—Onion Smut.
" 368.—The Cultivation of Flax for Fibre.

The following leaflets have been revised and brought up to date :—

No. 32.—Foul Brood or Bee Pest.
" 43.—Titmice.
" 57.—External Parasites of Poultry.
" 81.—A Substitute for Dishorning.
" 88.—Hop Aphis.
" 156.—Hedgerow Timber.
" 267.—Basic Slag.
" 306.—The Goat as a Source of Milk.
" 307.—The Wood Pigeon.
" 312.—Blossom-Wilt of Apples.
" 351.—The Improvement of Village Life.

The following leaflets have been withdrawn from circulation :—

No. 269. -Disease of Raspberry and Loganberry.
Sp. 35.—Transport of Agricultural Produce.
Sp. 61.—The Transport of Agricultural Requisites and Produce.

NOTICES OF BOOKS.

The Annual Report for 1920 and Year Book of the Essex County Farmers' Union.—(Price 2s. 6d. The Secretary of the Union is Mr. John B. Gill, Castledon Farm, Wickford, Essex). In addition to the usual official information this Report contains about forty short articles on matters of general agricultural interest. Among these Sir Henry Rew contributes an appeal for a sense of joint responsibility on the part of employers and employed. Mr. R. Robson and Miss E. W. Jameson collaborate in writing an article on the Insect Population of our Crops, stating a very telling case against frit flies, clover weevils and turnip fleabeetles. Other contributions deal with mole drainage, folding pigs, clean milk, and mushroom growing. The legal side of a farmer's work is provided for by notes on the Seeds Act, 1920, the Fertilisers and Feeding Stuffs Act and the Ecclesiastical Tithe (Rate) Act, 1920. There are over thirty well reproduced illustrations. Farmers in other counties, as well as those of Essex, should find the book distinctly useful.

Practical Dairying.—(Dora G. Saker. London: Methuen & Co., Ltd., 6s. net.) A useful book on Dairying written in a simple and practical style. The book should be of aid to Dairy Students, Farmers and all interested in Dairying. The chapters devoted to butter and cheesemaking are interesting and explicit, and the chapter on cleanliness in the production and handling of milk is worthy of special note.

The Breeding and Feeding of Farm Stock.—(James Wilson. London: Methuen & Co., Ltd., 6s. net.) Dealing in the first chapter with the Stockbreeder's Raw Materials, Professor Wilson gives a most interesting account of the history of British Cattle and Horses from pre-Roman days through the centuries. Prof. Wilson knows his history, and in addition he understands Mendel's Law. Through the application of this law to the records of history he gives a clear outline of the evolution of the modern breeds. With Sheep he has not dealt at such length, and at the present day when the pig occupies such an important place in the economies of Stock breeding it is rather regrettable that he has not dealt fully with the Raw Materials which went to make, and with the methods employed in the making of, modern pig breeds. With cattle and horses, however, the account deals thoroughly and makes interesting reading.

In the second and two subsequent chapters the author discusses the methods of the early breeders, and reviews their work in the light of Mendelism. Much of this had been done in his previous books, "The Principles of Stockbreeding" and "The Evolution of British Cattle," but here in his new book it is put in shorter more concise everyday language, and written in a way which is yet clear and exact, and intelligible to a reader who may have no knowledge of scientific principles.

As in his other books, he is inclined to show favour for the principle of "in-breeding." This question of "in-breeding" is a most difficult one, and if the practice is to be employed at all, it will surely be safe only in the hands of a Master. Bakewell, the Collings, Hugh Watson, were all great masters in their time, but how far will the greatest breeders of the present day advocate breeding in-and-in, or how many of them successfully practise it in its mildest forms with success over any length of period? Professor Wilson repeats again and again the importance of the principle of the tested sire—the importance of keeping the sire till his "class" can be determined from his progeny rather than by his own performance in the show ring, and it is a principle which will bear emphasising.

In the matter of feeding, the Author has made a most exhaustive study of investigations, carried out both on the Continent and at home. In particular he has studied the work done in Sweden and Denmark and thence brings useful lessons for the help of feeders and investigators. Much of this Swedish and Danish work is new to the British reader.

The final chapter is devoted to a useful method of calculating the money value of feeding stuffs, and the book concludes with tables giving the average composition of the common feeding stuffs, and figures showing the comparative feeding value of different foods, or in other words, the number of pounds of each feeding stuff necessary to make a food unit.

Altogether the book is one of the most valuable additions to the animal husbandry side of the agricultural library which has been published. It should find a place on the shelf of every stock breeder and feeder who wishes to probe into problems of breeding and feeding. He will find it a readable, instructive book giving him something to think about and much helpful, sound, practical advice. To the agricultural student and teacher it is invaluable, and embraces a subject sometimes rather inclined to be neglected in favour of the crop husbandry side. In short it is a good book containing a lot of useful, original work.

The Study of Agriculture.—(H. Cecil Pawson. London: Vinton & Co., Ltd. Price 5s. net.) In a small book under above title, Mr. H. Cecil Pawson, Lecturer in Agriculture in the University of Durham, has bridged over the considerable gaps in the information usually available to youths desiring to go in for one branch or another of agriculture. The book should be particularly useful to parents who, though their own pursuits lie in cities or towns, have the desire and means of satisfying their sons' taste for a country life. Of the real difficulty which exists for parents and youngsters alike in getting information and advice on a career that is foreign to them, Mr. Pawson is obviously well aware. Whatever is the final object of training in agriculture, a very big proportion of aspirants are ignorant of the most effective means of arriving at it. The book, however, is not written only for those who, after training, will be in a position to take a farm; it shows also the experience necessary to those who for want of capital or through particular aptitude will tend to become County Organisers, University Lecturers, Research Workers and so on. Within the wide sphere of agriculture many activities lie, and cases could be quoted of intending farmers of seventeen years becoming lecturers at twenty-seven, or of embryo land-agents finishing as officials. It is therefore of the greater importance that the spade work should be such as will qualify for almost any agricultural career, and the foundations must be sound in order to carry the superstructure of later years.

The reading of Mr. Pawson's book will be a revelation to a townsman. The author brings out briefly but clearly the wide nature of the subject, and furnishes a valuable bird's-eye view wherein one can trace the road to success in the different careers that agriculture offers. Practical knowledge must be the foundation of all. How best to acquire that knowledge and preserve it in a systematic way Mr. Pawson aims at showing. It is of the greatest importance for the student to go to a farm, and not only must the farmer be sound but able and willing to explain the business to the newcomer. Cases are met with in which, owing to disinclination or inability on the farmer's part to teach his pupil, the latter frequently learns little beyond the performance of manual tasks. This state of things is not only discouraging to the beginner, but is wasting his time. Like the "Farmer's boy" in the old-fashioned song, the pupil must learn

"To plough and sow, to reap and mow,"

but he is going to be a farmer or a lecturer, as the case may be, and there is much else to learn.

Three rules are given:—"Be observant, willing to learn, and of an enquiring mind." The author demonstrates the value of noting everything that appears important or unusual. He lays stress on the advantage of seeing other farms in the district, and, what is of particular importance to those who desire to attain to official and advisory posts, of gaining practical farming experience in different parts of the country. The time seems to have come when a rising generation of agriculturists amplify their practical experience by attending classes at Farm Institutes or Agricultural Colleges, or go up to a University. It seems that if those interested consulted the authorities of these colleges, not only before entering them, but before starting practical training, a much straighter path might be found to ultimate success. In this stage of the student's career the author has sound advice to

give. It should be borne in mind that the change is very considerable from the wide outlook and open air life on the farm to the steady application of hours of lectures and study. Here the rough but systematised notes of the farming days can be developed into an encyclopædic source of knowledge which will be of lifelong value.

Some readers of Mr. Pawson's book will realise from their own experience that had they been armed with such information when first they took to agriculture much time might have been saved and energy directed into more fruitful channels. If such be the case, the agricultural student of to-day has surely a big pull over his predecessors.

Milk Testing—(C. W. Walker-Tisdale. London: J. North, 3s. 6d. net.) This handbook is prepared specially for practical people to whom quick and reasonably accurate tests are of the greatest importance. It is a concise and practical handbook on milk testing, and contains a number of illustrations and test tables.

An Introduction to Bacterial Diseases of Plants.—(Erwin F. Smith, in charge of the Laboratory of Plant Pathology at Washington: W. B. Saunders, New York. 50s. net.) Most of the knowledge we have of the bacterial diseases of plants has come to us within the last generation. This subject has received much more attention in America than elsewhere. The bacterial origin of Fire-blight of Pear was the first to be discovered by Professor Burrill, of the University of Illinois, about 40 years ago. Since then progress has been slow, and at first doubt as to bacteria being the causal organisms of disease was widely felt.

The greater part of the work carried out in connection with bacterial diseases of plants has been done by Professor Erwin F. Smith, the author of the present work. It is primarily intended for the use of students working in a laboratory under the guidance of a teacher, but it is full of help and interest for all those who wish to have a more complete knowledge of research methods and experimental work in plant bacteriology.

The first part of the book gives a general review of bacterial diseases of plants—their geographical distribution, the susceptibility of plants to these diseases, the causes of their spread, and methods for their control. The second part deals with methods of research, and from the simplicity of the apparatus Professor E. F. Smith uses in his own research it is clear that elaborate apparatus is not necessary for experimental work in bacterial diseases of plants. The third part describes certain bacterial diseases well known in America, namely:—Cucurbit Wilt, Black Rot of Crucifers, Stewart's Disease of Maize, Brown Rot of Solanaceæ, Bacterial Canker of Tomato, Jones's Soft Rot of Carrot, &c., Bacterial Black Rot of the Potato, Bean Blight, McCulloch's Cauliflower Spot, Angular Leaf Spot of Cotton, Mulberry Blight, Fire-blight of Apple, Pear, Quince, &c., Olive Tubercle, and Crown Gall. Part four contains notes on some additional bacterial diseases, and discusses the question of stimuli—chemical and physical—underlying tumour-formation in bacterial diseases of plants. The author argues that his discoveries in connection with tumour-diseases caused by bacteria, particularly Crown Gall, have a profound relationship to animal cancer; the solution of this latter problem he believes to be very near. A few pages at the end of

the book are devoted to general observations on the duty of the scientist from several different aspects.

This book is the result of 35 years of reading and 25 years of diligent laboratory investigation. It is fully illustrated, containing 650 illustrations, which, with very few exceptions, are from the author's own laboratory.

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 4.

JULY, 1921.

NOTES FOR THE MONTH.

Proposed Repeal of Part I of the Agriculture Act, 1920.

In the House of Commons on 8th June, Lieut.-Col. the Right Hon. Sir Arthur Griffith-Boscawen, M.P., Minister of Agriculture, made the following announcement:—"The Government have been carefully considering for some time past the operation of the Agriculture Act, and have come to the conclusion that the financial liability on the State under Part I of the Agriculture Act is more than the country can afford under present circumstances, and consequently that there is no alternative but to terminate at the earliest possible date the policy guaranteeing minimum prices for wheat and oats. This decision involves also the repeal of the provisions relating to the minimum wage for agricultural workers and to the control of cultivation by the State, which are contained in Part I of the Agriculture Act and in the Corn Production Act. I may add that payments will, of course, have to be made in respect of the wheat and oats which will be harvested this year."

The attention of farmers is particularly directed to the final sentence of the above statement, from which it will be seen that payment will be made in respect of wheat and oats harvested in 1921.

Third Meeting of the Council of Agriculture for England.

The Third Meeting of the Council of Agriculture for England was held in the Council Chamber of the Middlesex Guildhall, Westminster, on 27th May, the Earl of Selborne, K.G., G.C.M.G., being in the Chair.

The Rt. Hon. Lt.-Col. Sir Arthur Griffith-Boscawen, M.P., Minister of Agriculture, and the Earl of Ancaster,

Parliamentary Secretary, were also present, and the Minister addressed the Council upon the subject matter of the two resolutions first taken.

The first resolution proposed to set up a committee to consider the constitution and mode of election of the Agricultural Advisory Committee, but was not passed, consideration of the matter being adjourned for twelve months.

A resolution on the subject of land reclamation was passed to the effect that, with the object of increasing the country's food production, the Government should be requested to initiate schemes when a time opportune for undertaking land reclamation had arrived. The question of the powers of Local Authorities to make Orders and Regulations governing the movement of livestock into their areas was discussed and referred to the Agricultural Advisory Committee.

The refusal of the Government to finance small drainage schemes under Sections 15 and 16 of the Land Drainage Act, 1918, was also considered, and a resolution was passed requesting the Treasury to reconsider its decision, especially in cases where it could be shown that such schemes are urgently necessary for land improvement and food production.

Sir Lawrence Weaver, on behalf of the Ministry of Agriculture, promised to include in the next Annual Report upon Allotments a return giving particulars in regard to land held by allotment-holders in each County Borough, Borough and Urban District Council on the 31st December last. An amendment that the information should be given for the previous three years also, if possible, was subsequently passed.

The question of railway facilities for handling perishable produce was raised in two resolutions to the following effect:—(1) That during the soft fruit season for a period of not less than five weeks in each year all railway goods stations handling substantial consignments of soft fruit should be kept open for this purpose for the same hours as before the War; and (2) That in the opinion of this Council all railway goods stations at which perishable produce is dispatched or received should be connected to the public telephone forthwith. Both were carried.

The final resolution dealt with the question of the retention by the Ministry of a woman officer for women's work in agricultural districts. It ran as follows:—"That this Council, while fully approving the action of the Government in reducing

the staffs of all departments with a view to economy, desires to urge that, having regard to the organisations now existing throughout the agricultural districts of the country for enlisting the interests of women in the reconstruction of rural life and rural industries, it is essential that the Ministry should retain a woman officer on its permanent staff." With the substitution of the word "advisable" for "essential" this resolution was carried by 17 votes to 12.

Home-grown Wheat Prices for July, 1921.

IN the May issue of this JOURNAL, particulars were given of the arrangements made as regards the price of home-grown wheat of the 1920 crop, and in the issue for June it was stated that for the month of June the average price properly receivable by growers was 86s. 6d. per 504 lb.

The Ministry is now informed that the Royal Commission on Wheat Supplies calculate that the cost of wheat imported during April, May and June was equivalent to 82s. per quarter of 504 lb. for home-grown wheat of sound milling quality. For the month of July, 1921, therefore, the average price properly receivable by growers for home-grown wheat of sound milling quality will be 82s. per 504 lb.

Reconstitution of the Horticultural Advisory Council.

THIS Council, which was first appointed during the War to advise the Ministry in regard to important horticultural questions, mainly of supply and prices, has been re-constituted and the number of its members reduced. On the formation of the Council, it was found necessary to appoint individual horticulturists whose opinions on the many and varied questions of the day were of weight, so that the Ministry might be in possession of the views and experience of men from all over the country.

Since the War and with the appointment of a Controller of Horticulture from the industry itself, however, it has become obvious that the Council was too unwieldy for present purposes. Further, the money at the disposal of the Department for the necessary expenses of the Council did not make it possible to call the Council together more than a very few times a year. The Department no doubt suffered on this account through the absence of full and direct contact with the

industry, especially before the appointment of the present Controller.

The scheme of reconstruction now approved requires that the members of the Council shall in future be appointed as representatives of particular interests or associations except in the case of the nominees of the Ministry. Members will accordingly be nominated by the following bodies or interests:—The National Farmers' Union, the Federation of British Growers, the Horticultural Trades Association, the Lea Valley Growers, the National Union of Allotment Holders, the Royal Horticultural Society, the National Federation of Fruit and Potato Trades Associations, the Retailers' Association, and the National Federation of Retail Fruiterers, &c., Limited, the British Florists' Association, the National Seed Trade, the Worshipful Company of Fruiterers, the British Fruit Preservers, the Cider Manufacturers, the Workers' Union, the National Union of Agricultural Works, and the Chamber of Horticulture.

This alteration will without doubt strengthen the Council and give added value to its advice on horticultural questions. In future, it will speak as a duly elected body of representatives covering the whole industry, and will be to some degree comparable with the Council of Agriculture for England, which was set up by the Ministry of Agriculture and Fisheries Act of 1919 to give advice on general agricultural matters. The number of members of the old Horticultural Council is cut down by nearly a half, and the economy resulting from this change, quite apart from the other advantages arising from it, will be considerable.

* * * * * *

Renovation of Farm Orchards.

THE West of England Farm Orchards Committee, appointed by the Ministry and attached to the Agricultural and Horticultural Research Institute, Long Ashton, Bristol, carried out in the autumn of 1919 an exhaustive survey of a total of 531 farm orchards in Devon, Gloucestershire, Somersetshire, Wiltshire, and Worcestershire, and, as a result of their investigations, recommended, *inter alia*, that demonstrations in orchard renovation and management should be given at suitable centres in each county. The Ministry has accordingly suggested to the County Committees of the West of England that they should take over some neglected grass orchards and renovate them, in order to demonstrate to farmers and others what can be done in this direction.

In arranging for such demonstrations Committees should, as far as possible, work on uniform lines. The selected orchards should be in districts where old orchards are plentiful; they should also be of average size, and near main roads. They should either be farmed by an owner-occupier or held under a lease, and, as a general rule, should be taken over for a period of not less than ten years. An agreement should be drawn up, and the consent of the landlord, as well as the tenant, obtained, so that in the case of any change of tenancy the work can be continued by the incoming tenant. The agreement should make the occupier responsible for the labour for carrying out the manual operations involved (planting, fencing, staking, pruning, heading back, top-grafting, spraying, grease banding, picking, storing, grading and packing, marketing, &c.) under instruction from the experts of the County Committee. These would be assisted by the County Committee and by the West of England Farm Orchards Committee acting in an advisory capacity.

The County Committee would undertake to supply to the farmer at cost price any new trees or grafts that may be required. These probably could be obtained from the Ministry's Research Stations at East Malling, Kent, or Long Ashton.

Under such a scheme the occupiers would supply the material for demonstrations and labour, while the County Committees would supply expert technical knowledge and direction for carrying out the work. It should be found, after a period of years, that orchards had increased their out-put many times over; and the owners and occupiers, besides reaping this advantage, would have the satisfaction of helping the district to acquire much useful knowledge, which should be of distinct commercial advantage.

The following is a list of the varieties of apples recommended for planting in the neglected orchards selected for demonstration:—

Dessert varieties.	*Culinary varieties.*
Allington Pippin.	Anne Elizabeth.
King of the Pippins.	Edward VII.
Blenheim Orange.	Warner's King.
Worcester Pearmain.	Bramley Seedling.
	Newton Wonder.
	Underleaf.
	Scotch Bridget.

Prices and Supplies of Agricultural Produce in 1920.

PART III of the Agricultural Statistics for 1920, which deals with the Prices and Supplies of Agicultural Produce during last year, has now been issued by the Ministry.* The Report refers to the continuance in 1920 of the rise in price of farm produce and of farm requisites which has been a feature of agriculture since the outbreak of war in 1914. In the case of certain commodities such as barley, oats, milk, cheese, potatoes and hay the maximum was reached in the early months of the year, and was followed by a substantial decline, whilst the prices of live stock and meat tended to rise. Feeding stuffs were only obtainable at very high prices during the greater part of the year, though in November and December a fall took place, and the prices of fertilisers were generally higher in 1920 than in 1919. On the average the prices of agricultural produce were 22 per cent. higher than in 1919 and some 192 per cent. above the mean of the three years 1911-13, while feeding stuffs were about 173 per cent. and fertilisers about 159 per cent. above the pre-war level. The average increase in the cash wages of agricultural labourers since the beginning of the War cannot be less than 180 to 190 per cent.

The general inference drawn from these figures is that while the gross agricultural receipts from sales of produce must have grown substantially, there has also been on the other side of the account a great increase in the cost of production. Part of the increased receipts must have been absorbed by the increased outlay on feeding stuffs, fertilisers, machinery, implements and seeds, in addition to the higher cost of labour, both regular and temporary. Other charges which have to be met out of receipts include interest on capital, rent and local rates.

The balance remaining after meeting all charges represents the remuneration for the labour, skill and experience of the occupiers of the 400,000 holdings in England and Wales. What is the extent of this balance cannot be estimated, but it need not be disputed that during the last six years farming has been more profitable than it was before the War. Formerly it was one of the least remunerative of occupations, and just as the wages of farm workers were unduly and unreasonably low, so the net return obtained by a substantial proportion of occupiers was relatively far less than the profits obtained in other industries involving the investment of similar capital.

The Report deals in detail with the prices and supplies of the

* Agricultural Statistics, 1920, Vol. LV, Part III, obtainable from H.M. Stationery Office, Kingsway, W.C.2.

principal classes of agricultural produce, feeding stuffs and fertilisers. Tables are included giving the imports of agricultural produce and requirements, the acreage and production of the chief grain crops, and the numbers of live stock in British Dominions and foreign countries.

* * * * * *

New Seed Regulations.

SINCE January, 1918, it has been necessary, under the Testing of Seeds Order, 1918, in the case of a sale of all the principal kinds of Grass, Clover, Field and Garden Seeds, for the seller to give a declaration with the seed as to its percentage of germination, percentage of purity, the presence of injurious weeds, and various other specified particulars. This Order was the first measure passed in this country for the purpose of controlling the sale of agricultural and garden seeds, and brought us into line with most of the countries on the Continent, the United States of America, and several of the British Dominions and Colonies, where, for a number of years, various regulations for the purpose of preventing the sale of seeds of low vitality and badly contaminated with injurious weed seeds have been in force. The success which has attended the operations of the Order, which was passed under the Defence of the Realm Regulations, and was therefore in itself a transitory measure, indicated the desirability of making its requirements permanent. This has been effected by the passing of the Seeds Act, 1920, which supersedes the Testing of Seeds Order, 1918, and comes into operation on the 1st August next.*

As in the case of the Order, the main requirement of the Act is that a declaration as to quality shall be given in the case of all sales of the principal farm and garden seeds. In the case of sales of seed potatoes, a declaration as to the class, variety, size and dressing will also be necessary, and the sale, or sowing, of seeds containing above a prescribed percentage of injurious weed seeds is prohibited. A further important innovation which will come into operation under the Act is that, in the case of seeds other than garden seeds, the test for the purpose of ascertaining particulars to be declared by the seller must be carried out at an Official Seed Testing Station, or at a private Testing Station licensed by the Ministry of Agriculture for that purpose. After the 1st August therefore, a

* The provisions of the Testing of Seeds Order, 1918, were given in this *Journal* for July, 1918, p. 477, and the main provision of the Seeds Act, 1920, in this *Journal* for October, 1920, p. 604.

declaration based on a test carried out at a non-licensed station will be illegal.

For the purpose of allowing a certain amount of elasticity to the requirements under the Act, the Ministry is authorised to issue Regulations with regard to details. The first set of Draft Regulations has now been prepared in consultation with all the interests concerned. These Regulations prescribe:—

(1) The Seeds to which the Act shall apply.
(2) The particulars to be given in the case of a sale or exposure for sale of seeds and seed potatoes.
(3) The Injurious Weed Seeds to which the Act shall apply.
(4) The method in which Samples must be taken for the purpose of testing.
(5) The Form of Certificate to be issued by the Official Seed Testing Station.
(6) The authorised Minimum Percentage of Germination which, in the case of certain kinds of seeds, may be declared instead of the actual percentage of germination.
(7) The limits of variation in respect of the percentage of germination and of the percentage of purity which are permitted for the purpose of any legal proceedings on a contract for the sale of seeds.
(8) Various other matters which, under the Act, have to be prescribed.

The main provisions of the Draft Regulations, which will remain in draft form for a period of 40 days from 10th June, after which they will be made and presented to both Houses of Parliament, are given at p. 370.

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Seed Testing Conference at Copenhagen.

THE Third International Seed Testing Conference was held at Copenhagen during the week ending 11th June. Seventeen countries were represented, chiefly by the Directors of Official Seed Testing Stations, and four delegates were present on behalf of Great Britain. The papers discussed dealt in the main with purely technical questions, but some of the proceedings were devoted to questions of the control of seed supply, both legislative and voluntary. Sir Lawrence Weaver communicated a paper on The British Seeds Act, 1920, and at the close of the Congress moved the following resolutions, which were unanimously adopted:—

(1) That an Association of Official Seed Analysts and Seed Control Organisations of Europe be formed.

(2) That a Committee consisting of Dr. Volkart, Mr. Bruijning, and Mr. Dorph Petersen (Directors of the Swiss, Dutch, and Danish Official Seed Testing Stations respectively) consider the constitution of the Association, rules of its membership and work, and circulate their recommendations to the members of the Conference.

(3) That the same Committee should consider—

(*a*) the unification of seed-testing methods in Europe, keeping in view the possibility of ultimate unification with North America;

(*b*) the method of expressing the results of analysis and the quality of the seeds analysed;—

and present a report to the next International Conference.

(4) That on the invitation of the Minister of Agriculture and Fisheries the next International Conference be held at the end of June, 1924, in England, partly in London and partly in Cambridge.

A more detailed account of the proceedings of the Conference, by Mr. C. B. Saunders, Chief Officer of the Official Seed Testing Station for England and Wales, will appear in a later issue of the JOURNAL.

A COURT LEET.

THE EARL OF SELBORNE, K.G., G.C.M.G.

IF the Law of Property Bill now before Parliament becomes an Act, one result, so I am told, will be that Courts Leet, which have existed in England almost from time immemorial, will cease to be held. I was very glad therefore to have the opportunity of attending two such courts lately, each held in the best room of the public house of a beautiful Dorsetshire village. I had never attended such a court before and was curious to see what happened. I cannot say that the business transacted, though necessary, was very important, but it was transacted with much formality according to the ancient observances.

The Steward of the Manor commenced the proceedings by reading a document which began " Oh yes, Oh yes, Oh yes," and, as he read a sentence, the predestined foreman of the jury repeated it after him. The foreman of the jury was then sworn on the New Testament in very thorough-going fashion and after him the four other members of the jury swore " to do the same things and in the same manner as our foreman has sworn." The Steward then read a formal address to the jury and asked them for their " presentations." In one case the important matters were the state of the ditches, watercourses, sheep dips, and sinkholes. In the other case memories were racked to present a correct list of the deaths of copy-holders (and, more important still, of persons by whose lives copy-holds were held) which had taken place since the last court was held in May, 1920.

Three clear impressions remain with me from my experience.

The dignity and gravity with which these proceedings were conducted reminded me once again what a strong instinct of ritualism is really latent in the English character. I have noticed it again and again at the functions of the Friendly Societies, when the members, all agricultural labourers, mechanics, tradesmen or farmers of some South country village, dress themselves up as elaborately as a Knight of the Garter for a Chapter at Windsor, and wear these strange garments all through a hot summer afternoon with an ease and unconscious dignity which might well be envied by a Knight. But one day I was myself initiated into one of these great Societies, and it is not an exaggeration to say that the ritual of that " initiation " equalled anything that I have seen at a State function of any sort, or even at High Mass on some special occasion in a Roman Catholic Church in France or Italy.

On this occasion there were no dresses, scarves, or regalia, but there was an elaborate formality and an ancient liturgy which were scrupulously observed. One juror told me that he had attended this Court for forty years without a break and that as long as he could drag one leg after the other he should not think of missing it. And yet there are people who would ask you to believe that tradition and conservatism of personal habits are intellectual funguses, which cling only to the superannuated squire or farmer and which are unknown to the up-to-date trades unionist agricultural labourer! What nonsense some people who live in towns, do talk about us, who live in the country!

Among the jurors of these courts and other inhabitants of these two small villages. whom I met later, were four farmers, all of whom had started life as agricultural labourers. One of these, a man of not more than 50 years of age, occupied 1,000 acres, of which half was down and the other half meadow and arable. The other three occupied farms of 50 to 150 acres. This experience quite confirmed all my previous experience. I have never known a country district or anything definite about a country district without meeting case after case of the farmer who began life as an agricultural labourer; and, if this is true to-day, is it not probable that it was true yesterday and therefore that some of the farmers I see and meet are the sons of men who began life as agricultural labourers, and so back generation after generation. And if this is true of those parts of England, of which I know something definite or which I know intimately, surely it would be strange if it were not true of the other parts of England also, which I do not know!

The truth is that the agricultural labourer is not born in a cul-de-sac, as some people contend, and never has been. There never has been a time, I suspect, since all Englishmen became free men in the full sense of that term, when an agricultural labourer of marked character and ability could not rise to become a farmer, and I suspect that the cases in which he has done so within the last century have been much more numerous than is generally supposed. This is not an argument for not making the path easier for the agricultural labourer to become an occupier and owner of land by every sensible means in our power—on the contrary, it is a very strong argument in favour of the wisdom of such a course. But it is an equally clear disproof of the statement often made that the agricultural labourer was reduced to such a position in the 18th century that it was impossible for him to rise out of it except by

deserting his own countryside for the towns or for the Colonies. It is also true that all the time the most fit of the agricultural labourers have been rising, the least fit of the farmers and of the landowners have been falling. When such a family comes down in the world its members have a tendency to leave the old neighbourhood for the towns or the Colonies, but I have myself known agricultural labourers whose forefathers were farmers, and I have heard of others whose forefathers were the owners of the land on which they worked. This process of natural selection is surely healthy for the countryside so long as it is not stimulated and made unnatural by the operation of unwise or oppressive laws.

My third impression was that a worse form of tenure than a copyhold for lives has never been invented by the laziness of man. For consider how it operates—a copyhold is held for three named lives from the lord of the manor. The holding must have started some time or other, and then presumably the first copyholder paid a handsome sum to the lord of the manor, in return for which he was allowed to name three persons, and then for as long as one of those three was alive he could not be called upon to pay any rent for the land, though he had to make certain comparatively small payments on stipulated occasions. The lives named were sometimes those of local persons and at other times members of the Royal Family or of well-known public character. The Duke of Connaught's name, I was told, was often to be found in connection with these Dorsetshire copyholds. When one of these lives died the copyholder asked to be allowed to name another, for which privilege he was prepared to pay a comparatively large sum down. For the lord of the manor, who was the real freeholder, this was a preposterous system. In the course of years it meant receiving occasional lump sums down and the loss of an annual economic rent which would have added up to a far larger sum. He was also relieved of all responsibility for the land or buildings and cottages, and could not interfere with the copyholder's treatment of the land or cottages.

For the copyholder this would have been a very profitable bargain if he could have been assured of its perpetuity; but a day came when the lord of the manor returned to sanity and refused to renew the lives, determined to regain control of his own land when the last life lapsed, to put his property into proper order and to let the farm at an economic rent. But from the moment that he received the refusal of a renewal of

lives, the continuous interest of the copyholder in the land he held ceased to exist, and in too many cases from that moment he began to grudge the expenditure of a penny on the repair of cottages or buildings or fences or gates, and the annual sum disbursed on the necessary repairs dwindled to a vanishing point as the years went on and the lives became older.

Sometimes it happened that the last two lives lasted on many years and the lord of the manor had to look on impotently while he saw good cottages and substantial farm buildings melting away into deplorable ruins. And the urban critic came down and was righteously indignant at the state of the cottages, and demanded the name of the local magnate and went away and denounced him, and had no suspicion that the real responsibility for the wretched cottages rested with a man who lived in one of them and for the wretched system with men who had been dead for centuries.

THE DAIRY SHORTHORN.

ROBERT HOBBS, Kelmscott.

THE economic value of a dual-purpose breed of cattle to the community as a whole would appear to be in some danger of being overlooked, and the tendency at the moment is rather to consider the merits of such cattle from the point of view of the individual farmer. Writing, however, as one whose father and grandfather both demonstrated the great value and, in certain circumstances, the indispensability of dual-purpose cattle, I find that thirty years' personal experience, emphasised particularly during the last seven years, has but served to strengthen my conviction that, to serve a densely populated country, dual utility cattle are one of the supreme factors in the production of the three great food essentials—grain, meat and milk, with the products of the latter, cheese and butter.

To-day no country with any economic self-respect is content to take the native breed of cattle as good enough for its own particular needs; it demands something capable of meeting, in the greatest possible degree, the requirements created by climate and its peculiar social conditions. Thus it is to be understood that in new and therefore undeveloped countries, where vast tracts of land are to be had at merely nominal values, as in the wheat-growing districts of the United States and Canada and the grazing ranches of Argentina, beef production and grain crops are the predominant considerations with the agriculturist. In Argentina, in point of fact, milk production beyond the level necessary for the rearing of the calves born on the ranches is regarded in the light of a nuisance. On the other hand, in the dairy districts of Australia and New Zealand, beefing qualities are almost entirely ignored. So long as the regions immediately adjoining these, agriculturally speaking, "single-purpose areas" undergo no further development the single aim remains, but the moment the surrounding country makes appreciable industrial growth the agricultural development takes another course. It may almost be said that it is not until the population increases greatly and large cities make their appearance that the proper development of agriculture commences. The first consequence of industrial extension upon the farming of the district is an attempt to meet the demand for cattle which are capable of

producing a good yield of milk, calves suitable for grazing into bullocks of high quality, and a good carcass of beef at the end of their milking days.

It is not surprising, therefore, to find that the popularity of an animal meeting these needs so well as the Dairy Shorthorn is extending far beyond the United Kingdom, where it has held sway for upwards of a century as the farmer's cow, and is penetrating deeper and deeper into the newer countries of the world. Especially is this extension to be noticed in the more thickly populated districts of the Eastern States of America, in South America, South Africa and New Zealand, and, in fact, in most parts of the world where population is growing at a greater rate than the production of food.

At home the Dairy Shorthorn has successfully passed through times of difficulty and some danger. At no period was its future more seriously threatened as a double-purpose animal than during the earlier days of the demand from Argentina for heavily-fleshed Shorthorns. The high prices then paid, and the particular type which was bred in consequence, were responsible for the disregard of the milking qualities which, even among the very early improvers of the "Durham," were so characteristic of the breed. The danger increased when there began the indiscriminate crossing of heavy milking English cows with the thick-fleshed Cruickshank bulls. Fortunately this menace to the future of the breed was recognised in time by a few enthusiasts, by whose efforts the Shorthorn was saved from becoming primarily a beef animal. These breeders succeeded in persuading the Shorthorn Society to offer prizes at the principal agricultural shows throughout England, Scotland and Ireland for pedigree Shorthorn dairy cows; then they formed the Dairy Shorthorn Association and secured affiliation with the Shorthorn Society. Milk recording in pedigree herds was encouraged, but the most important step in the history of the Association will probably prove to be the publication of the Register of Non-pedigree Dairy Shorthorns whose progeny may gradually qualify for admission to the Herd Book. By these measures the heavy milking powers of the breed were rescued from the neglect which at one time seriously threatened them.

The Government Live Stock Improvement Schemes, including the grants through the Ministry of Agriculture for encouraging the breeding of high-class commercial stock, with separate grants to the Milk Recording Societies, have

also afforded a valuable stimulus to the breeding of well-fleshed bulls from milk-recorded cows, with the result that the importance of the dual utility animal, and the extent to which the Dairy Shorthorn answers the need for it were never more deeply appreciated. It may be of interest to point to the growth of the Dairy Shorthorn Association. In 1914 it comprised 214 members, with 55 herds and 337 milk records. In 1920 the membership had risen to 631, the herds to 332, and the milk records to 1,194. In December, 1918, the Association published the first volume of the Register of Non-pedigree Shorthorn Dairy Cows, in which close upon a thousand approved milking Shorthorns were enrolled as foundation cows. The Register and the milk recording scheme have naturally led to the improvement of prices for non-pedigree cattle with milk records, and herds have been dispersed at an average of from £107 to £114 per head, with individual prices up to 270 guineas.

A word of warning may not be out of place in view of the rapid extension of the milk recording system. Here and there a tendency may be observed towards pushing milk production to excess. What is needed most of all is a gradual raising of the standard of breeding and management, and an improvement in the methods of feeding, so as to enable the production of the greatest volume of milk consistent with the lowest economic cost, and without placing an undue strain on the cow. At the recent sales of recorded cattle there have been signs that these points are realised by a very large body of farmers and breeders, for there has been a steady demand for the right sort of cow. It appears to be recognised by a large number of farmers that the cow as a mere milking machine is a risky proposition, and this risk, in conjunction with the extravagant cost of maintenance both in food and labour, and the general inability of the calves bred from such cows to grow into profitable feeders, has affected the demand for the "shelly" cow. To command the highest market figure to-day the cow or heifer must be wide, deep and level, of good Shorthorn character, carrying a square, well-hung bag with well-placed teats of medium size, being neither too short nor coarse or "bottled." The demand for this class of animal is practically insatiable, and in consequence such cows top the ordinary market price in no matter what part of the country they are offered.

The breeding of Dairy Shorthorns offers many advantages

to the ordinary beginner with a limited amount of capital. In the first place the breed is the most widely-found of all breeds, and is the popular general purpose animal in practically every county of England or Ireland. This ensures that wherever they may be bred there is always a market, whether for calves, young stores, down calvers, or fat beasts.

A second advantage is that it is immaterial whether the beginner is farming a grass farm, a mixed farm, or a farm wholly arable, for the dual-purpose Shorthorn is at home on either one or the other, and is quite adaptable to the feeding and management in either case. Nor does it matter to the owner of the Shorthorn in what form he is marketing his milk product, whether as whole milk, cheese, or butter.

Further, the Shorthorn is the only established breed of cattle remaining in this country which still has an open herd book, and if the embargo on foreign cattle continues, there is little fear of the Shorthorn Herd Book being closed for many years. Apart from any other consideration, this is of tremendous advantage to beginners, and although the Shorthorn Society still requires four crosses from a foundation dam of Shorthorn type before accepting heifers for entry in Coates's Herd Book, registration may now begin in the Dairy Shorthorn Register as soon as an approved cow has yielded 8,000 lb. in one year or 6,500 lb. a year for two consecutive years, provided she is of a suitable Shorthorn type. Thus the beginner's interest, as well as the enhanced value of the cow and her offspring, commences at once, and he may safely add an average of from £5 to £10 in value for each pure cross by a pedigree Shorthorn milk bull on heifers descended from these registered cows, until the descendants in the fourth generation become eligible for the Herd Book proper. After this has been achieved, with sufficient good looks and sound records behind them, there is no reason why they should not, in many instances, realise very high prices and produce valuable breeding animals.

THE "BUCKEYE" DITCHER FOR LAND DRAINAGE: TRIAL IN CAMBRIDGESHIRE.

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MANUAL labour in digging and laying drains on stiff land last winter probably cost about £15 per acre. Expenditure on this scale, coupled with the long period required to complete the work, and the increasing difficulty of obtaining skilled men to carry it out, is doubtless preventing much tile drainage from being undertaken. The question therefore arises whether some type of draining-machine can perform the excavating work in an economical and satisfactory manner.

An American machine, the "Buckeye" Traction Ditcher, recently imported by the Scottish Board of Agriculture, was reputed to have been highly successful in Scotland, and more detailed information with regard to its capabilities was felt to be necessary. The Ministry of Agriculture and Fisheries therefore arranged for the loan of the "Buckeye" Drainer from the Scottish Board for a trial on Sir Douglas Newton's estate at Croxton, Cambridgeshire.

The "Buckeye" arrived at St. Neots station on August 18th, 1920, and travelled to Croxton Park by road under its own power, a distance of about 4 miles. The trial lasted for three weeks and included a public demonstration on September 3rd; during this time the machine was under the writer's observation.

Description.—Ditch tractors follow in principle the methods adopted in the construction of rock and earth excavators used by railway and mining contractors. They are made on one of two systems—buckets mounted on a rotating wheel or buckets carried on a moving endless belt. The "Buckeye" Tractor Ditcher described here is designed on the rotating wheel system, and the following is an abridged specification :—

20 h.p. four-cylinder petrol engine.

Digging wheel	11½ in. or 14½ in. wide × 4½ ft. deep.
	or 11½ in. wide × 5½ ft. deep.
Length over all	25 ft.
Width over wheels	8 ft. 6 in.
Extreme height	8 ft. 9 in.
Digging speeds	2½ ft. to 9 ft. per minute.
Road speeds	1 to 1½ miles per hour.

Approximate shipping weight ...	7·9 tons.
Width of front wheels	10 in.
Width of extension tyres to front wheels	8 in.
Width of caterpillar track	22 in.
Centre of ditch to centre of spoil bank	4 ft. 3 in.

The chief points of the machine may be briefly outlined as follows:—

A substantial main frame and platform constructed of steel I-beams connected at intervals by cross beams and strongly reinforced, carries at one end a 20 h.p. engine unit and transmission system, and at the other the cutting wheel hinged to the platform. The frame and superstructure are supported at both ends on three-point suspension trucks which eliminate severe twisting strains. The front truck carrying the engine is mounted on two heavy wheels; the truck carrying the rear of the frame is supported by large rollers, with case-hardened shells and chilled bearings, running on a jointed steel caterpillar track, the treads of which are of steel plate and hard wood, driven by endless chains running over sprockets. The large bearing surface afforded by these tracks minimises the pressure per square foot and enables the excavator to travel over soft ground.

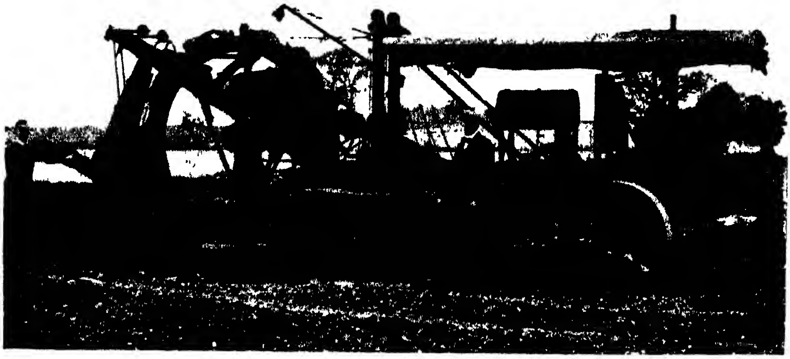
The digging wheel is mounted midway between the two main girders and is held in a three-point suspension frame hinged to the main platform. Power is transmitted to the wheel by a system of chains running on sprocket wheels; and by shifting a high speed chain from one set of a series of graduated sprockets to another, four digging speeds ranging from 2½ ft. to 9 ft. per minute can be obtained. The machine is, of course, stopped to move the chain, but the plan is found to be highly satisfactory and effective.

A feature of the transmission system is a safety device in the form of a friction cone clutch, which slips when the machine strikes an obstruction beyond its capacity, thus averting a breakdown. On the outside rim of the digging wheel are mounted buckets of deep section which can be suitably equipped for varying classes of work. For digging in stony ground, picks are attached to the rims of the buckets, and the back of each bucket is closed by a removable plate. In dry sands the picks are replaced by curved cutting extensions, and the backs are retained. In wet clays the cutting extensions are employed, but the backs are removed, and the buckets are cleared as they revolve by a set of iron fingers held rigid on the wheel-frame, which pass through each bucket

in turn and scrape out the clay. In all cases the excavated earth falls on a rotating clearing canvas and is deposited in a neat pile alongside the trench.

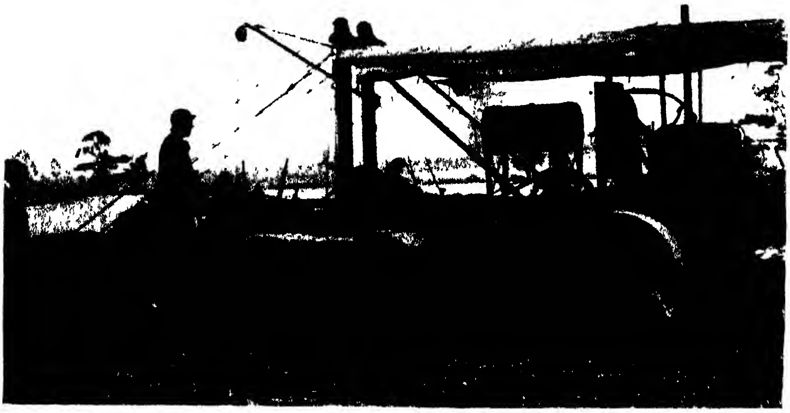
Adjustment of the depth of the digging wheel is obtained by a hoist worked from the engine and operated through a double boom, the cables communicating with both the front and the rear of the wheel-frame. If the digging wheel is rotated and lowered, keeping the forward end of the wheel-frame some 3 ft. lower than its rear end, the buckets will dig themselves into the ground at this angle as the whole machine is advanced. At some prearranged depth the descent is checked by means of the front cables; the rear cables are then slackened, allowing the curved sole which follows the digging wheel to take the weight of the rear of the wheel and thus mould and smooth the floor of the trench.

The method of adjusting the depth of the trench, in order to obtain a drain of even fall when the machine passes over uneven land, is of such practical importance that it may be described in some detail. The system is shown diagrammatically in Fig. 4, in which A B C represents an irregular surface below which the drain has to be cut. At intervals of about 50 yd. along this line, levels are taken in the usual way. Having decided the fall required in the drain, the depths below the surface at which the floor of the trench must lie at A, B and C are calculated. Suppose these depths are 4 ft. 6 in., 3 ft. and 4 ft., respectively, as in the diagram (where F G represents the bottom of the drain and F H the horizontal). The next operation is to erect standards fitted with movable cross-members at A. B and C. The cross-members must be adjusted in correlation with a horizontal sighting rod D fixed to the frame of the digging wheel E of the drainer. If this sighting rod is fixed 9 ft. above the lowest part of the wheel, it is then 9 ft. above the floor of the drain, and the cross-members on the standards must be so fixed that they, too, are 9 ft. above the level at which the floor of the drain is to be dug. Thus the cross-member at A will be 4 ft. 6 in. above the ground, that at B will be 6 ft. above the ground, and so on. The cross-members must be all in line, since the drain is to be cut with an even fall. The machine is then moved to the outlet end A of the drain, since digging always proceeds uphill, and made to face along the line of standards. The digging wheel is caused to cut its way into the ground. When the sighting rod intersects the line of cross-members, the further



Photo] [Albone, St. Neots.

FIG. 1. The machine at rest.



Photo] [Albone, St. Neots.

FIG. 2. The machine at work.

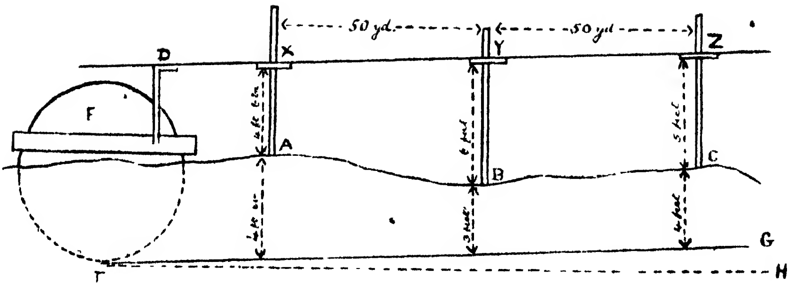


FIG. 4. Diagram showing the method of adjusting the depth of the trench when the machine passes over uneven land.

Photo] [*Albone, St. Neots.*

FIG. 3.—Back view of the machine when at work.

descent of the wheel is stopped by the winding gear, as previously described, for the bottom of the wheel has now reached the level of the floor of the trench. The drainer now proceeds along the line of the proposed drain, and the driver must keep the sighting rod constantly in alignment with the cross-members by raising or lowering the digging wheel in accordance with any irregularities of the land. If this is done carefully, a trench with an even fall can be excavated in one operation. It must be emphasised that any carelessness in the matter of sighting will involve subsequent grading of parts of the trench by hand: this actually occurred on several occasions during the trial.

Organisation.—Before the arrival of the machine, a scheme for the drainage of the land should be decided out, preferably with the assistance of a surveyor, who will mark out on the ground the position of outfalls, mains and minors, take levels at suitable points along the various drains, placing in the ground pegs bearing the number of feet above the surface at which the cross-member should be placed at each point to give the correct fall in the drain.

The staff required by the machine consists of two men—a driver, who must be a skilled mechanic, and an assistant. Although one man can run the machine if all goes well, the other must be immediately available to attend to the sighting rods and to assist in case of repairs. With this arrangement the men could work in shifts if long running hours were desired.

When the drainer arrives, the surveyor should explain to the driver the plan of the proposed drains; the latter can then erect his standards and cross-members according to directions left on the pegs, and excavations can be commenced.

A boy should be provided to deal with the small quantity of earth which drops back on to the heel of the machine and thence into the bottom of the trench. He rides in the trench on the extreme rear of the drainer and clears out with a shovel the earth as it accumulates on the heel of the machine. The quantity of earth which finds its way back into the trench can be minimised by fitting to the rear of the machine a metal apron, which brushes loose material from the edge of the excavation. Two types of aprons were tried at Croxton, but neither could keep the bottom of the trench quite clear, particularly when the machine was working at a high speed in loose soil.

Arrangements should be made to lay the pipes close behind the machine, as delay in doing this will probably result in loose earth falling into the finished excavations.

Conditions Encountered.—The soil at Croxton is a stiff boulder clay of considerable thickness which, as explored to a depth of 4 ft. 6 in. by the excavator, contained a few large boulders and bands of chalk pebbles mixed with gravel. In places, however, uniform sticky clay was found to the full depth of the drains.

Fields of two types were attempted:—The demonstration field was a 12-acre bare-fallow of gentle and fairly uniform slope. There was about 5 in. of dry friable soil on the surface, but below the clay was moist and sticky owing to the conservation of water by the fallowing operations. In the upper parts of the field, bands of chalky gravel were found in the clay. The other set of conditions encountered consisted of wheat stubbles; these presented hard-baked clay surfaces resting on dry clay of a type containing rather more chalk and gravel than in the wetter parts of the demonstration field: the comparative dryness of the subsoil here was no doubt due to the absorption of water by the roots of the wheat crop.

The mechanical analyses given in Table I show the nature of the various fields just described. Since the bulk of the earth excavated by the machine consisted of subsoil, the analytical figures for the respective subsoils probably give a

TABLE I, showing percentages of Constituents.

Soil number.	Stones.	Moisture.	Organic Matter.	Fine Gravel.	Coarse Sand.	Fine Sand.	Coarse Silt.	Fine Silt.	Clay.	Chalk.	Total percentage of water at time of excavating.	Area represented by sample.
1	7·0	2·0	6·8	5	8·6	17·9	7·5	14·2	32·0	7·4	14·2	Surface of the stiffer and wetter parts of demonstration field.
2	·4	2·4	8·0	1·1	5·7	12·2	9·5	9·3	35·0	12·3	21·7	Subsoil of above.
3	1·9	2·0	6·6	1·7	15·8	22·5	7·5	10·7	27·0	6·2	10·6	Surface of drier and more chalky parts of demonstration field.
4	8·0	1·3	2·0	·5	9·0	10·1	4·8	5·5	14·0	43·4	16·5	Subsoil of above.
5	2·0	2·1	5·8	·5	10·6	18·8	7·5	15·8	27·6	5·4	16·1	Surface of the stubble fields.
6	3·3	2·1	1·0	3·0	4·5	14·0	6·0	11·0	27·0	27·4	15·5	Subsoil of above.

better measure of the digging conditions than do the figures for the corresponding surface soils. The former will therefore be considered more fully than the latter.

Samples 1 and 2 show clearly the exceedingly stiff and wet nature of the lower part of the demonstration field. The subsoil contains as much as 35 per cent. of clay and 9 per cent. of fine silt, while its water content of 21·7 per cent. is by far the highest of any of the samples analysed.

Soils 3 and 4 indicate that while the surface soil is substantially the same as in the previous case, the subsoil is of an entirely different type, being drier (16·5 per cent. water), considerably more calcareous (43·4 per cent. chalk), and containing a relatively high percentage of stones (8 per cent.).

The stubble fields, as represented by samples 5 and 6, show 27 per cent. of clay and 11 per cent. of fine silt in the subsoil. This denotes a heavy subsoil. On the other hand, the water content of 15·5 per cent. is low, and the amount of chalk (27·4 per cent.) is considerable.

It was subsequently found that the drainer could operate more rapidly at any given depth in a dry clay subsoil containing chalk and gravel than in a wet clay subsoil.

The weather conditions during the trial were very favourable; no heavy rain fell. There were a few showers, but the soil was never soaked, and the machine could always be worked without any risk of damage to the texture of the land.

TABLE II.

Date.		Hours Lost by Break-downs.	Hours Adjusting and Repairing.	Hours Working.	Gallons Fuel.	Gallons Oil.	Lb. Grease.	Chains 3 ft. 6 in. mains.	Chains 2 ft. 6 in minors.
19/8/20	..	1½	3	¾	2½	¾	½	1⅕	—
20/8/20	..	2½	1¼	3	8	1¾	—	6	—
21/8/20	...	—	¼	½	1½	—	—	½	—
23/8/20	...	—	2	4	11	2	—	6⅕	1
24/8/20	...	—	½	5¾	11¾	2	½	—	14½
25/8/20	...	1½	1¾	6	11½	2¼	½	—	21½
26/8/20	...	—	2¼	5	9½	1¼	¼	—	19⅕
27/8/20	...	—	2½	4¼	8½	2	5	—	17⅕
28/8/20	...	3	½	—	—	—	—	—	—
30/8/20	...	—	5¼	1	4¾	1¾	—	1¼	3
31/8/20	...	1½	1	3¼	7¼	¾	—	8¾	—
1/9/20	...	—	2½	3¾	9	2½	¼	12½	—
3/9/20	...	—	½	6¼	13½	2	—	6	36½
4/9/20	...	—	½	¾	2	1¼	—	2¼	—
6/9/20	...	—	¾	5¼	13½	1½	—	24*	—
7/9/20	...	1	1	3¼	8½	1	1	4*	21½†
8/9/20	...	6	—	—	—	—	—	—	—
9/9/20	...	6	—	—	—	—	—	—	—

Mains 2 ft. 9 in.
† Minors 2 ft.

Digging Accomplished.—Few who saw the "Buckeye" in operation could fail to be impressed by the way in which it

performed the work. Mains 4 ft. 6 in. deep were dug at the rate of three linear feet per minute in the stiffest and wettest part of the demonstration field. Boulders were either broken down and thrown out in pieces or else raised entire; moist clay was delivered in large lumps; dry clay in small flakes resembling cracked linseed cake.

On the day of the demonstration the machine was working continuously from 10.30 a.m. till 4.30 p.m., and in these 6 hours it completed 6 chains of 3 ft. 6 in. mains and 36 chains of 2 ft. 6 in. minors; the latter were excavated on top gear at 12 ft. per minute. About 200 people visited the ground, and the speed and efficiency with which the work was done was favourably commented upon.

Data Obtained.—In Table II will be found a summarised statement of the observations made during each working day of the trial. A few words of explanation are necessary with regard to the headings of the columns. "Hours lost through breakdowns" comprises the time during which the machine was rendered idle by some part having to be taken to a smithy or repair shop. "Hours adjusting and repairing" represents the time spent on altering the setting of the machine to face new soil conditions, and on minor repairs or replacements performed on the spot, and also includes time spent on oiling, &c., before starting. "Hours working" includes the time when the machine was actually excavating, moving overland from the end of one drain to the beginning of the next, and travelling small distances by farm roads from one field to another. The fuel used was benzol, and, on a few occasions, 2nd grade petrol. The lubricant was heavy cylinder oil. On two occasions, September 6th and 7th, the depths of the drains dug were not as stated at the head of the last two columns; the depth of the mains on these days was only 2 ft. 9 in., and the minors only 2 feet.

As an example of a typical day, August 25th may be quoted. There was a stoppage of 1½ hours for a blacksmith's repair; 1¾ hours in minor adjustments in the field; and a period of 6 hours was actually spent in digging 21½ chains of 2 ft. 6 in. minors in stiff wet clay, 11½ gallons of benzol, 2¼ gallons of cylinder oil, and about ½ lb. of grease being consumed. August 19th was an exceptional day, when much time was spent in adapting the machine to local conditions. On this occasion the machine followed a curved main, a type of work for which it was not suited, owing to the length of the

sole which travelled in the trench, the result being that only $1\frac{1}{5}$ chains were dug by the use of $2\frac{1}{2}$ gallons of fuel. August 21st and September 4th were Saturdays, when the men ceased work at noon; very little digging was done, and there is no doubt that the figures for these days should not be regarded as true measures of what the drainer could perform in half-a-day under commercial conditions.

It will be observed that four days are unaccounted for in the table. Three were Sundays, and September 2nd was spent in a general cleaning and overhauling in preparation for the demonstration. Three days were completely lost by breakdowns; August 28th was a Saturday, hence only three lost hours are recorded; September 8th and 9th were idle on account of replacing a broken pinion. On September 10th the machine was put on the train for Scotland. If September 8th and 9th, when the machine was idle owing to the broken pinion, be excluded, it can be calculated that the average working day was $5\frac{2}{3}$ hours. Of this, $\frac{2}{3}$ of an hour was lost by breakdowns, $1\frac{2}{3}$ hours by adjustments, and $3\frac{1}{3}$ hours were spent in actual digging.

These figures are disappointing, but it should be realised that conditions of management were exceptional during the trial. Several troublesome stoppages should not have occurred: for example, the machine was put out of action by the dog connecting the magneto shaft to the engine becoming gradually worn out. By careful overhauling it should have been possible to detect the fault and avert a breakdown. It might be said, without labouring the point, that the conditions under which the men were working were not conducive to the biggest output. At the demonstration, when the men were doing their best, the machine dug continuously for 6 hours without a hitch; but admitting that special preparations had been made for that day, there is no doubt that, given stricter supervision or some system of payment by results, the average digging day could have been increased materially.

The consumption of fuel and lubricating oil calculated from the daily figures of the whole trial worked out at an average of $2\frac{1}{3}$ gallons of benzol and $\frac{2}{5}$ gallons of cylinder oil per running hour.

Table III shows the performance of the machine when digging at certain depths in various classes of land. Figures for each type of work were taken from Table II covering as long a period as possible; for example, the four days

August 24th to 27th, inclusive, gave the information concerning the rate of digging 2 ft. 6 in. minors in wet clay. The column headed "Tons of earth excavated per hour" was derived from determinations of the density of the undisturbed soil and the dimensions of the trenches.

TABLE III.

Type of earth excavated.	*Depth of trench.*	*Chains trench dug per gallon.*	*Chains trench dug per hour.*	*Gallons per hour.*	*Tons of earth excavated per hour.*
Moist stiff clay..	3 ft. 6 in.	·64 ch.	1·7 ch.	2·8 gal.	18 tons
Moist stiff clay..	2 ,, 6 ,,	1·76 ,,	3·5 ,,	2·0 ,,	25 ,,
Dry clay with flints and chalk	3 ,, 6 ,,	1·30 ,,	3·0 ,,	2·3 ,,	31 ,,
Dry clay with flints and chalk	2 ,, 9 ,,	1·78 ,,	4·6 ,,	2·6 ,,	37 ,,
Dry clay with flints and chalk	2 ,, 0 ,,	3·41 ,,	9·0 ,,	2·6 ,,	52 ,,

It will be observed that the rate of excavation measured in chains per hour increases rapidly as the trench becomes shallower, the type of soil being the same. This is due not to the machine excavating a lesser weight of earth per hour, for the last column in Table III shows that the weight of earth excavated increases rapidly as the depth of trench decreases; nor is it due to a higher lift, which in each case is the same. The increase in speed with the shallow drains is due in part to lesser friction between the digging wheel and the sides of the trench. Indeed, this friction accounts for a great proportion of the power used in digging, and is well brought out in comparing the rate of digging 3 ft. 6 in. trenches in moist clay at 1.7 chains per hour with 3 chains per hour for trenches of the same depth in dry clay, in which the friction is much less.

The rate of fuel consumption, given in gallons per hour in the fifth column of the table, is roughly constant at all speeds. It varies in fact from 2 to 2.8 gallons per hour. One of the reasons for this constant consumption of fuel is that the machine is fitted with an automatic cut-out, which acts like a governor and causes the engine to run at constant speed.

The table also gives an indication of how much work could be done under the various conditions of depth and soil if it were kept running, *e.g.*, for 7 hours per day. Under these conditions some 63 chains of 2 ft. minors could be dug in

dry clay, or 21 chains of 3 ft. 6 in. mains in similar clay, or 12 chains of 3 ft. 6 in. mains in wet clay.

Mechanical Considerations.—The excellence of the engine and mechanism was remarked upon by all engineers who examined the drainer, and there is no doubt that the machine is well designed for cutting trenches in all classes of land. The engine was designed to burn petrol, which certainly seemed uneconomical in this type of heavy-duty motor. Undoubtedly the cost of fuel could have been reduced by 30 per cent. if an efficient form of vaporiser had been fitted to burn paraffin. The machine was intended primarily for use in America, where distillate is cheap, and probably the manufacturers had not considered the fuel question for England. During the trial second grade petrol and benzol were the fuels used.

The safety device previously described only acted on two or three occasions, for on striking an obstruction the driving chains usually broke (or jumped their pinions) before the clutch slipped. This clutch was undoubtedly out of adjustment, and if it had been attended to there would have been less trouble with the chains, and a fruitful source of minor delays would have been removed.

The width of the trenches dug for the 2 in. tiles was criticised by practical men. It was pointed out that there was too much lateral play in a drain 11 in. wide at the bottom. To remedy this Mr. Thompson Close, the Ministry's inspector, arranged for an iron tile-mould to be fixed to the bottom of the sole of the machine, its function being to make a groove in the floor of the trench of the exact size to take the 2 in. tiles. This was an improvement. In any case, some unnecessary earth is excavated when digging for small pipes, and if the digging width could be reduced to, say, 8 in., which should offer no mechanical difficulties, economies should be effected. On the other hand, very narrow drains, if deep, are difficult for men to work in, should such drains subsequently need deepening or grading before the tiles are laid; again, if wider trenches are dug, a relatively large amount of earth is disturbed, which may give a quicker percolation and render the drains more effective.

The machine was provided with a large assortment of spares, but two breakdowns involving castings necessitated workshop repairs. On four occasions minor jobs had to be taken to the local smithy. In noting these stoppages, however, it should

be remembered that the machine had been in constant and heavy use for the previous eighteen months. Certain delays are to be regarded as of normal occurrence: the sides of the digging wheel had to be cleared of clay from time to time when excavating in wet patches; large stones had occasionally to be dislodged from the buckets; worn links had to be replaced in the driving chains; and on moving from one type of land to another it would sometimes be necessary to substitute the cutting extensions on the rims of the buckets by picks, or *vice versâ*.

Costs.—The total expenses incurred in connection with the drainer during the trial may be summarised thus:—

	£	s.	d.
Fuel:—122 gal.	22	14	8
Cartage of fuel to drainer in the field (1 man + 1 horse for 2 days at 16s.)	1	12	0
Lubricants:—			
Oil (22½ gal. at 8s. 2d.)	9	1	9
Grease (7 lb. at 1s.)		7	0
	£33	15	5
Wages:—			
1 man and 1 boy (2⅔ weeks at £7 10s.)	£20	0	0

To the above must be added capital charges. The machine would probably not be running continuously throughout the year; assuming that it is used for only 6 months each year, an estimate of the capital charges may be made by charging interest at 7 per cent. and depreciation at 15 per cent. The total cost of the machine, with spares, including freightage to Scotland, was £1,414. Thus the annual charges are:—

	£	s.	d.
Interest at 7 per cent. on £1,414	98	19	6
Depreciation at 15 per cent. on £1,414	212	2	0
	£311	1	6

that is, the cost per week, assuming 26 running weeks per year, is £11 19s. 4d., and the cost for the duration of the trial, 2⅔ weeks, was £31 18s. 3d. For repairs and maintenance the machine cost £10 3s. 9d. during the trial, of which £1 5s. 0d. was expended on a tile-mould and can fairly be deducted as a permanent improvement. This leaves repairs at £8 18s. 9d.

The summary below shows in the first column of figures the actual costs of the machine for the full period of 2⅔ weeks, from the time it entered the first field until the digging operations ceased on September 7th. The second column gives a calculation of the costs of operating the machine for

TABLE IV.

	For the trial.	Per running hour, actual.	Per running hour, under commercial conditions.
	£ s. d.	£ s. d.	£ s. d.
Fuel, lubricants, &c. ...	33 15 5	12 9	12 0
Wages	20 0 0	7 6¼	4 10
Interest and Depreciation	31 18 3	12 0½	5 8
Repairs	8 18 9	3 4	3 4
	£94 12 5	£1 15 8	£1 5 10

each running hour of the 53 hours during which the machine was actually digging. Referring now to Table III, which gives the chains of trench actually excavated per running hour under various conditions, we are enabled easily to calculate the cost of excavating such trenches; thus:—

3 ft. 6 in. trenches in moist stiff clay, where 1·7 chains were excavated per hour, cost 20s. 11d. per chain.
2 ft. 6 in. trenches in similar clay, cost 10s. 2d. per chain.
3 ft. 6 in. trenches in dry clay „ 11s. 11d. per chain.
2 ft. 9 in. trenches in dry clay „ 7s. 9d. per chain.
2 ft. trenches in dry clay „ 4s. 0d. per chain.

It has previously been indicated that, from the nature of the case, the organisation of labour left something to be desired; there were none of the usual incentives to speedy work which play so important a part in successful commercial organisation, and consequently the hours actually spent in digging, approximately only 3⅓ per day, are capable of being greatly augmented, both by a longer working day and by speeding-up repairs. A working day of, say, 10 hours, during 7 hours of which the machine is actually digging, should be possible. If this were done, the expenses under certain of the headings would be reduced greatly, and it is interesting to examine how these might be effected. The first item, fuel, lubricants, &c., would not be affected much, because fuel consumption is roughly proportional to work done; none the less, short running hours inevitably lead to uneconomical consumption of fuel and some economy would result, possibly 12s. per hour instead of 12s. 9d., from longer running hours.

The men were paid for a nominal working day of 8 hours, which, in fact, was rarely attained. If they were working a 10-hour instead of an 8-hour day, and were paid time-and-a half for the extra time, the cost for the period would have been increased from £20 to £27 10s., but assuming the drainer to have been running 7 hours each day, the cost per

hour for wages would have been reduced from 7s. 6½d. to 4s. 10d. Interest and depreciation would have remained constant for the period, but the cost per running hour on this head would have been reduced to 5s. 8d. Repairs may be expected to remain the same per running hour as in the actual experiment.

The last column in Table IV gives a sum of these estimates equal to £1 5s. 10d. per running hour, and referring again to Table III for the work done per running hour we obtain the costs per chain in each case as follows:—

	s.	d.
3 ft. 6 in. drains in moist clay	15	2
2 ft. 6 in. drains in moist clay	7	4
3 ft. 6 in. drains in dry clay	8	7
2 ft. 9 in. drains in dry clay	5	7
2 ft. drains in dry clay	2	10

The fact which is brought out most strikingly by a consideration of these figures is that the costs of digging in a dry subsoil are much reduced. Since the machine was not used on wet clay, it is impossible to say whether the cost of digging in wet clay would be greater or less than in moist clay, but the figures suggest that the best financial results will be obtained in summer use.

The next point to note is that the cost of shallow drains is very much less than that of deep ones; thus 3 ft. 6 in. drains in dry clay cost exactly three times as much to dig as 2 ft. drains in similar soil. So pronounced a result was contrary to original anticipations.

Comparing the cost of digging trenches with the "Buckeye" with that by hand is not an easy matter unless the work be carried on side by side. At the demonstration the cost of excavating the 3 ft. 6 in. mains which, under commercial conditions, we have shown might be 15s. 2d. per chain in moist clay and 8s. 7d. in dry clay, was estimated by practical farmers who saw the work to be between 12s. and 17s. per chain if dug by hand at present prices. The cost of digging 2 ft. 6 in. drains in clay at the present time would probably approximate 6s. per chain, which may be compared with 7s. 4d., the estimated cost per chain for 2 ft. 6 in. drains in moist clay and with 5s. 7d. the cost per chain for 2 ft. 6 in. drains in dry clay. Similarly, the cost of 2 ft. drains in clay if dug by hand would probably cost now about 4s. per chain as compared with 2s. 10d. by the "Buckeye" in dry clay. It is to be noted further that, provided the man who controls

the drainer is reasonably careful, the work of "bottoming" before laying the tiles is negligible, so that further economy may result here. On the other hand, if the operator is careless, the cost of "bottoming" as compared with hand digging, may be excessive.

One other advantage is to be claimed for the "Buckeye" Drainer, namely, speed of work. The rate at which draining can be done by hand is phenomenally slow. A man can scarcely excavate 2 chains of 2 ft. 6 in. trench in a day of 8 hours, while the "Buckeye" can do it in dry clay in about 20 minutes. Lastly, hand draining is very heavy work which few labourers relish.

Further Developments.—The trial showed that the friction produced by the revolution of the digging wheel in moist clay greatly retarded the speed of work and raised the cost. This friction was chiefly between the outside rims of the wheel, to which the clay adhered, and the sides of the trench; it was necessary frequently to stop and attempt to clear the rims. If scrapers could be fixed to the framework and adjusted to remove the adhering clay from the sides of the wheel, much of the friction would be obviated and increased economy of working obtained.

The digging wheel is designed to be fitted with digging buckets of two sizes; the small size excavates a trench 11½ in. wide and the large size one of 14½ in. In the trials at Croxton the small-sized buckets were used throughout for both mains and minor drains. For main drains, if men must work in them to adjust grades in cases of error in digging, 11½ in. is the smallest practicable size, but for shallow drains 11 in. is extravagant. If the digging wheel were smaller, so as to dig a maximum drain of 11 in. and a minor of 8 in., considerable economy of fuel might be expected, and, consequently, greater speed of work.

Not only is the "Buckeye" suitable for displacing hand labour in digging drains for "thorough" draining, but it is also suitable for digging the mains in co-operation with the mole plough, especially on land with a slight fall or irregular surface, where frequent mains are essential.

The success of the "Buckeye" at Croxton warrants a more extensive use of the implement under commercial conditions, but the capital involved is too great to justify its purchase by farmers unless they are farming on a very extensive scale. It is an implement which may well be purchased by a land-

owner having a large area of land needing drainage, or by an agricultural engineer in a similar district who would contract to drain land by the use of the "Buckeye" just as he now contracts to drain with the mole-plough.

Conclusions.—1. The "Buckeye" Drainer proved itself capable of excavating straight trenches for land drainage to any depth not exceeding 4 ft. 6 in.

2. It was not successful in excavating trenches with a curve approximating to a right angle—which is sometimes necessary where the main has to be led to its outfall; under such conditions, it is better to build a catchpit at the angle of the bend.

3. Trenches were excavated at varying speeds according to depth and moisture of subsoil; 3 ft. 6 in. drains in moist clay were dug at the rate of 1.7 chains per running hour, and in dry clay at 3.0 chains per hour; 2 ft. drains in dry clay at 9 chains per hour.

4. In the experiment the costs of working were high, because of the conditions under which labour was employed. An attempt has been made on a conservative basis to estimate the costs of operating under commercial conditions, and they compare favourably with present costs of hand digging.

5. If the "Buckeye" Drainer were fitted with a wheel and buckets capable of digging trenches 11 in. as a maximum and 8 in. as a minimum, instead of 14½ in. maximum and 11½ in. minimum, considerable economy in costs of operating might be expected.

6. The implement is not suitable for farmers to purchase unless operating on a very large scale; it is suitable for use by agricultural contractors or by landowners with large estates needing drainage.

In conclusion, my thanks are due to Mr. Arthur Amos, M.A., of the School of Agriculture, Cambridge, for planning the observations recorded here and assisting with the report; to Mr. Thompson Close, the Ministry's Inspector, for valuable help with the more technical details of the trial; to Mr. L. F. Newman, M.A., of the School of Agriculture, Cambridge, for kindly undertaking the analyses; and to Sir Douglas Newton and his staff for facilitating the observations.

GRADING AND PACKING OF FRUIT.

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AT present very few people interested in the fruit industry would deny that those trading in fruit have a grievance. The fruit sent to them by growers might be packed in a far better manner, but before any improvements can be made it becomes necessary for the grower to realise this point, to select good sound fruit of various sizes and quality, and to pack it in a suitable package, in order that it may be distributed through the trade to the consumer with the least possible loss of freshness. No doubt many growers in the past have done this, but since the wholesaler and the retailer have not recognised these sound and honest packages of fruit, the cash returned to the grower has not repaid him for the extra labour which he has employed. To guard against this it may be an essential part of the scheme for the grower to use a label on which may be described the weight, variety, quality and grade of the fruit. In some measure the label becomes a form of contract between the grower and the retailer. So that these guaranteed packages of fruit can be easily recognised amongst the ordinarily marketed packages, the label should be somewhat conspicuous in design. In all probability even this would be insufficient, for though any grower in this country might pack fruit in a perfectly honest manner, and use a label of his own, it would take a very considerable time for him to establish the worth of such a personal label, in our complicated marketing system. Experience in marketing in this country, chiefly in connection with produce from the glass house industry, has shown that it is possible for even an individual grower's trade-mark to be of considerable value, though no doubt the time for this to become established has been considerable. Time is an important factor, and if large numbers of growers are to give up their old methods of packing and marketing fruit for a newer system, which will involve more labour, additional expense and detailed supervision, they must be assured of an immediate increased return. It may therefore be necessary for the label to be guaranteed by some official body, such as a Growers' Federation of some considerable importance, or even by a Department of the Government. In other countries the label has been guaranteed, sometimes by a Government Department (as in South Africa and California), and sometimes

by a Growers' Association, with a certain measure of assistance from Government Departments—a practice which has proved successful in Canada.

A review of the Canadian and American literature on this subject will show that in the majority of instances the growers' organisations started all these measures of reform on a voluntary basis. but before an extension of the scheme was possible it was necessary to secure Government assistance with legislation. There is a genuine desire to avoid legislation here if the reform measures can be established on a voluntary basis. The legislation in other countries was generally in the direction of defining standards for certain grades and classes of fruit, though in some cases it definitely decided the weight of goods to be sold in each package, and the size of the package which was to contain the fruit. In a few instances also, legislation provided that all the fruit was to be labelled and ascribed to its proper class.

The question has rightly been asked in America: "What is the object of legislation, laying down standards for produce of this nature?" and the answer has been that standardisation, in establishing a guide to the measure of quantity, weight, extent and value, sets up a standard for a given commodity, and classifies other commodities by comparison with the given standard. Such a standard will stabilise the business by providing a common ground whereon the buyer can meet the seller with the assurance that each is talking in the same understandable language. Most of the grievances of trade are due to the lack of this common language.

The various sections of the horticultural industry have recently considered this matter very carefully among themselves and in consultation with Government Departments. They have in fact considered a scheme put forward by the Ministry for dealing with this problem. There is undoubtedly a genuine desire among the best growers of this country to regard the defects as the business of the growers, and they propose to deal with this matter with a definite scheme of their own through the Growers' Associations, and to seek no aid from the Government, other than advice and some little assistance in the initial stages. The desire of the growers to put their own business in order is a right one, and a very welcome one, and it is the hope of the retailer and the wholesaler that the scheme will succeed. The scheme of the Ministry will remain in abeyance, but the plans are at the disposal of the Growers'

Association for their use if they decide to accept them. If this growers' scheme should fail, it is recognised that probably the next step of reform to be asked for by the retailers would be legislation, which in itself would mean some measure of control of the industry, a matter which neither Government Departments nor growers would welcome.

Growers' Scheme.—It would be necessary for the Association of Growers, having decided to adopt a scheme, to have a large supply of labels printed and distributed throughout the country by some organisation to individual growers, from whom it would be necessary to obtain guarantees that the labels would be properly used and in accordance with the conditions imposed. In theory it does not appear necessary for the packing of the growers to be carefully inspected before the packages are sent to the market, as the salesmen and retailers would soon discover any discrepancies. The conditions attaching to the use of the label would need the most careful consideration, but on the following points most people are agreed :—

(1) That the Growers' Association's name should appear on the label.

(2) That the label should only be used for certain agreed varieties of fruit, and the name should be stated on the label.

(3) That the grower before despatching the package should state on the label the number or name by which he is known to his Growers' Association, the class, quality or grade of fruit within the package, and the net weight or count of the fruit.

These are essential points that the salesman and the retailer can reasonably ask to know, and should be regarded as indispensable. Provided that the label is only used in a proper manner, no complaints would be received, a state of affairs not likely to exist for long. Some people through carelessness, and others through ignorance, might possibly use the label for packages for which labels were not intended, and complaints would arise. To trace the events as they are likely to occur it may be assumed that those receiving packages of fruit bearing these guaranteed labels, the contents of which do not comply with the description on the label as to weight, variety, grade or quality, would undoubtedly seek satisfaction from the sellers of the goods, and in many cases adjustments would be made. In cases of failure the matter would, no doubt, be reported to the Growers' Association named on the label, and it would be necessary for the Association to make such investigations as are necessary, and attempt to effect a settlement. If unsuccessful, the matter can only be dealt with by arbitration, and perhaps this is the most difficult part of the scheme to

work, for it may be necessary in most of the large marketing centres to set up tribunals of arbitration, the constitution of which would include representatives of the Growers', Wholesalers' and Retailers' Associations. These tribunals would act in their respective markets, and give decisions as to the classification of packages of fruit wrongly described. Settlement on the decisions would follow. An essential part of a scheme must give due consideration to finance; nor is it shown to what extent the Growers' Association are financially responsible for the packing of fruit bearing their authorised labels.*

A scheme of this nature instituted solely by the growers can only succeed if it has the support of the wholesaler and the retailer, and in the past they have turned all the blame for the present unsatisfactory marketing on to the shoulders of the grower. There are many ways in which the salesmen can render assistance. It has been stated that many growers have in the past adopted proper methods of grading and packing, but the market returns did not show any extra value for the goods, and as they had previously expended money in extra labour charges they discontinued the practice. It is now the duty of salesmen to look out for labelled packages, and in selling them to see that some extra price is obtained for the extra attention given. It should be their duty to co-operate with the growers and the Growers' Association in working the scheme and to facilitate the settling of complaints. At present each small consignment has to be dealt with separately by a salesman, much waste of time is caused in the markets, and his charges for labour are heavy. Under the new scheme, if he is dealing with standard packages, the consignments may be bulked together, and sold as per sample. This will lead to reduced space and labour costs, a portion of which may be reflected in the charges returned to the grower. The salesman and the retailer can co-operate to encourage the more extended use of fruit, especially home-grown fruit.

Before this scheme can be launched and put into practice it would be necessary for decisions to be made in many matters of detail—some trivial and some important. None, however, will be more difficult or more controversial than the question of the "package." Those in use to-day have been selected either because of cheapness, usefulness for preserving the freshness of fruit, or ease in handling.

A grower in this country supplying goods direct to the retail shops naturally finds it most convenient to use a package which

*All these are details which can be settled after further experience has been gained.

can easily be filled and easily emptied, provided it is of sufficient strength to protect the goods during the short journey in the carts. For this class of carrier it is almost immaterial whether it is a box, barrel, basket, or even a tray. Growers situated at considerable distances from the shops, who are thereby compelled to send their goods by rail to the markets, would select packages strong enough to stand a long journey, easy to handle, and light when empty, and this is probably the reason why baskets in preference to boxes have been chosen. Growers situated in other countries wishing to send their fruit to this country have other factors to consider, the two most important of which are, that the fruit has to be packed and held firm by the package to permit of no jolting during the journey, and the package has to be of such size and shape that when large numbers are stored in the ship's hold there is the minimum loss in space. A rectangular wooden box of some strength was suitable for this purpose—which is probably the explanation of its selection.

This does not necessarily mean, or in any way prove, that the wooden box is superior to the basket, but only that it is superior for shipment. Insomuch, however, that before boxes can be properly packed with fruit the produce must have undergone a most careful grading, and therefore in bulk presents a good appearance when purchased, they have become popular in the English markets, and it is not unlikely that British fruit growers may have to consider this feature, and to select the box as the future package for some of the best varieties of fruit. Financial consideration, of course, must be very carefully considered; the box is an expensive package and it may be only possible to use it for expensive varieties of dessert apples. Whether the price realised for culinary varieties, except for the choice samples, would allow growers to use boxes is a matter for further consideration. Future experience alone will decide, but so far as can be seen at present, larger wooden packages, such as half-barrels, would appear to be the more economical package.

In conclusion it has been proved that the present methods of growing and marketing fruit, if persisted in will leave an easy field in the British markets for imported apples. It should be the immediate duty of all persons engaged in the industry to co-operate to put this matter on a sound business basis, so that the grower, the wholesaler, the retailer, and the consumer will all be satisfied with British grown fruit.

RESEARCH IN ANIMAL BREEDING.

IV.

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In the previous articles of this series, published in the April and May issues of the JOURNAL, *Professor Punnett dealt with the coat colours in cattle and the crossing of polled with horned cattle as illustrations of simple Mendelian inheritance. In the June issue of the* JOURNAL *a description was given of the experiments undertaken with poultry and rabbits which were designed to investigate the inheritance of weight and coat patterns.*

ONE of the most striking points of difference between the higher animals and plants is that in the former the sexes are separate, while the latter are most often hermaphrodite. Associated with the bisexual mode of reproduction are peculiar features of heredity which have formed the subject of active investigation in recent years. As the result of much work in different parts of the world, the tangle of sex and its dependent characters is gradually being unravelled. In the first place we recognise sex itself as being inherited on Mendelian lines. Speaking generally, one of the features of sex-heredity is that the two sexes are produced in equal numbers. Male and female give males and females in like proportion, and it will be remembered (p. 15) that recessive and impure dominant give recessives and impure dominants in like proportion. Hence the conception that one sex is recessive and the other an impure dominant. The pure dominant can never arise, for male cannot be fertilised by male, nor female by female. Then comes the question, which sex is to be regarded as recessive, and which the impure dominant—which is the sex that produces germ-cells all of the same sex, and which the one that produces equal numbers of two kinds of germ-cells differing in their sex-determining properties? Experience has shown that there is no general rule for all animals. In man the male produces two kinds of sperms, but in the case of poultry it is the hen that produces two kinds of eggs; on the other hand women and cocks agree in that each produces only one kind of germ-cell in respect of sex-determination. In man the two kinds of sperm decide the sex of the child; in the fowl the two kinds of egg determine whether there shall hatch out a cockerel chick or a pullet.

Earlier experiments, conducted in Cambridge, had revealed the existence of a peculiar form of inheritance to which the name sex-linked heredity was given. The nature of this may be illustrated by a case of the sort which was investigated on the University Farm. In discussing the Hamburgh-Sebright cross used for the weight experiments we stated that the Hamburgh was a gold pencilled, and the Sebright a silver. These colours were deliberately chosen as there was some evidence that gold and silver formed an alternative pair, and that the case was one of sex-linked heredity. The experimental work showed that this was so. Silver behaves as a simple dominant to gold, but in the hen the transmission of the factor for silver is sex-linked. The silver hen, no matter how bred, is never pure for the silver factor; half of her eggs are "silver" and half are "gold." Moreover she transmits the silver factor to her male-producing eggs, and the gold to her female-producing ones. If we denote silver by *S*, and gold by *s*, and maleness and femaleness by *M* and *F* respectively, then the constitution of the silver hen is *MFSs*. Such a hen forms two kinds of eggs only, viz., those bearing maleness and silver (*MS*), and those bearing femaleness and gold (*Fs*); and they are formed in equal numbers. This is at once apparent when she is mated with a gold male, *MMss*. All of the sperms of such a cockerel are of the same kind in respect of these factors, viz., *Ms*. The male eggs of the silver hen (*MS*), when fertilised by the sperm of the gold cockerel (*Ms*) give birds of the constitution *MMSs*, *i.e.*, silver males. The female eggs of the silver hen (*Fs*) when similarly fertilised, give birds of the constitution *MFss*, *i.e.*, gold females. We have bred a great number of birds from the mating of silver hen and gold cockerel, and have never met an exception to the rule that the cockerels all come silver, and the pullets all gold.

This peculiar sex-linked type of inheritance is found in several other characters in poultry. It was demonstrated in America to hold good for the character of barred plumage such as is found in Plymouth Rocks. Barring is dominant to self black, but the barred hen is never pure for the barred factor. She transmits barring to her sons and black to her daughters. When mated with a black cockerel she gives only barred cockerels and black pullets. This observation we have been able to confirm in the course of our experiments.

As has already been pointed out in this *Journal*,* sex-linked

* The Early Elimination of Surplus Cockerels, by R. C. Punnett. *Jour. of the Bd. of Agric.*, February, 1919, p. 1319.

inheritance may prove to be of economic importance for the poultry breeder. Golds and silvers can be distinguished in the downs of the newly hatched chicks. By mating hens belonging to the silver class with cockerels belonging to the gold class, it is possible to tell the sexes apart *with certainty* immediately they hatch, and this is also true when barred hens are mated with black cockerels. By making use of suitable crosses the breeder of poultry for egg production can be sure of rearing nothing but pullets through the earlier and more costly stages. If the method were more generally followed, the poultry population of these islands would consist of a far higher proportion of the more valuable hen, and a markedly higher total production of eggs for the same expenditure of food and labour.

During the course of our work we have kept a number of pure breeds, and we have also made many crosses between them. A point that has impressed us greatly is the superiority of the first-cross birds as compared with the pure breeds. Under the same conditions the hatching power has been distinctly better, the chicks have been stronger, and mortality among them has been markedly less than for the pure-breed birds. The results have often been so striking that we feel it would be to the interest of utility poultry breeders if more extended trials could be undertaken. Carefully devised experiments of this kind might also be expected to throw light upon some of the vexed problems associated with inbreeding and crossbreeding.

Our investigations into sex-linked heredity have served to confirm and extend the earlier work at Cambridge, where the phenomenon was first discovered; and we should state that even ampler confirmation has been provided by other workers, notably in the United States. It is a phenomenon of great importance to the breeder, for it undoubtedly plays a large part in the heredity of animals with bisexual reproduction. Moreover the understanding of it may prove to be of high economic value. Professor Pearl in America has published an account of some experiments which suggest that high fecundity in poultry is transmitted on these lines. The highest grade of laying hen owes this quality to the possession of a definite laying factor. But she is never pure for this factor, and, as it is sex-linked in heredity, she transmits it only to her sons. The high-grade layers therefore must get this factor from their father, and the high prices paid to-day for the sons of hens with a high egg record is evidence that the enlightened breeder is already taking advantage of Pearl's experimental work. There

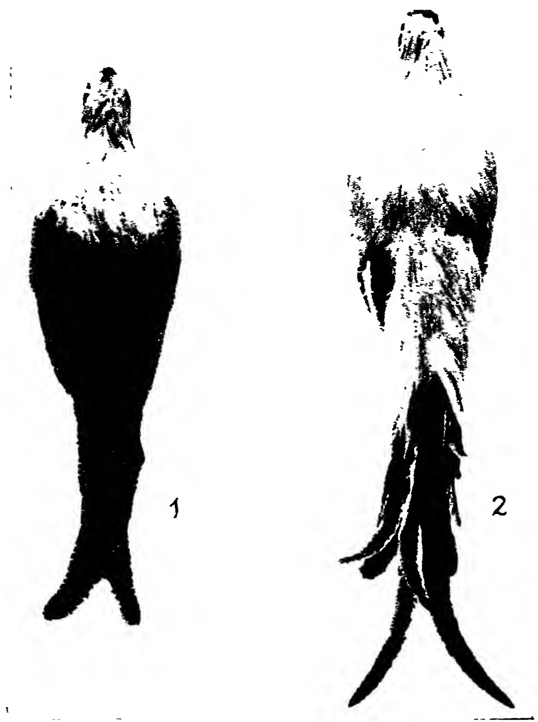

PLATE 1.—Skins of two silver-pencilled Hamburgh cocks, bred from the same hen. Fig. 1 is the skin of a henny cock, and Fig. 2 the skin of a normal-plumaged cock.

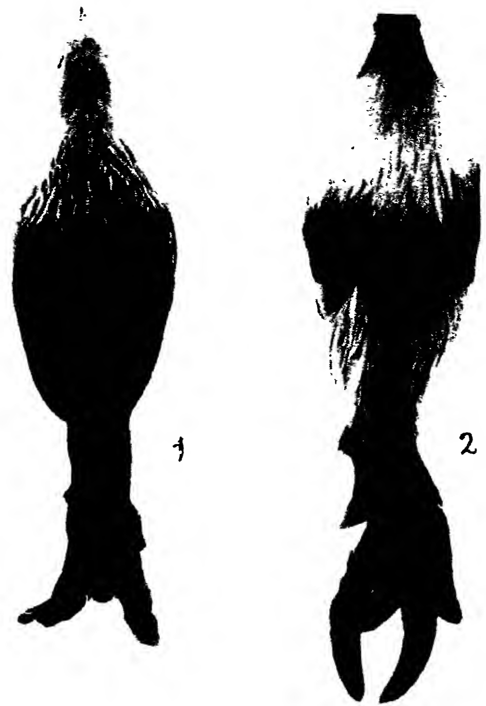

PLATE 2.—Fig. 1, skin of a henny cock. Fig. 2, skin of a castrated henny cock which moulted into normal plumage after the operation. Before the operation the bird was very similar to the one shown in Fig. 1.

is evidence too that some factor leading to increased milk yield in cattle is transmitted on the same lines. Here, however, sex-linked transmission is by the bull, not by the cow. For cattle, like men, are mammals, and it is probably the male in mammals that produces two kinds of sperm differing in their sex-determining properties, while the female produces only one kind of ovum. The bull may transmit something to his daughters that he does not transmit to his sons.

The Cambridge work has also included another series of experiments dealing with a character of which the transmission is closely wrapped up with that of sex. In certain breeds of poultry the cock is feathered like the hen. He lacks the long hackles of the neck and saddle, and the curved tail sickles of the normal male, their places being taken by feathers such as are normally found in hens. This feature of henny feathering in the cockerel is found in Sebright Bantams, Campines, Henry Game, and occasionally also in other breeds such as the Hamburghs (see Plate 1, Fig. 1). In our experiments the character was introduced by means of the Sebright Bantam. We found that henny feathering was dependent upon a definite factor, and that henny feathering in the cock is dominant to normal feathering. In its first plumage the henny cock may be intermediate between henny and normal feathering, but when this is the case he takes on the henny plumage at his first moult. Either sex in henny breeds can transmit the henny factor. From a bird of a pure henny breed, whether cock or hen, crossed with a bird of a normal breed, all the cocks produced are henny. The hens, however, are like normal hens in appearance, nor is it possible to distinguish hens which transmit henny feathering to their sons from those that do not. The interesting point then arises as to how we are to regard normal breeds where the hens are hen-feathered and the cocks are cock-feathered. A marked step towards the solution of this problem was made by Pézard in France, and Goodale in America. Both these observers found that complete removal of the ovary, a very difficult operation, led to the castrated hen assuming cock-like plumage at the moult. The obvious inference is that the normal hen is potentially cock-plumaged, but that she forms a substance in the ovary which circulates in the blood, inhibiting the development of cock plumage, and rendering her henny. Further, since we can attribute henny feathering in the cock to a definite factor, we are led to suppose that the hen of normal breeds also carries this factor, though she transmits it only to her daughters, and

they again only to their daughters. Interesting support of this view is derived from the results of castrating henny cocks. It is well known that castration of normal cocks has no marked effect, and that the plumage of the capon is similar to that of the uncastrated bird. Castration of the henny cock, however, results in the bird assuming the normal cock plumage at the moult. This was first demonstrated by Morgan and Goodale in America, and has since been confirmed by Dr. F. H. A. Marshall in Cambridge. Plate 2 shows the skins of a henny cock, and of a castrated henny cock which, after moulting, assumed the plumage of a normal Brown Leghorn. Before castration this bird closely resembled the henny cock shown in Plate 2, Fig. 1.

We must suppose that in the henny cock, as in the hen, the henny type of feathering is due to some substance circulating in the blood, inhibiting the production of normal male feathering. Moreover, this substance must be produced by the genital gland in the henny cock as in the hen. It may be produced by a testis as well as by an ovary. The hen is not hen-feathered in virtue of her femaleness, but because she has received from her mother a definite factor which she transmits only to her daughters in the sex-linked way. At some time or other in the history of the fowl this factor went, as it were, astray, and entered into a male-producing egg; though how this came about we do not at present know. When, however, the dislocation happened it became possible to take advantage of it, and to build it up as a breed character. It is well known that the henny Sebright Bantams owe this peculiarity to a casual henny bantam cock that Sir John Sebright noticed about a century ago. Whatever may be the economic outcome, it is evident that the analysis of such cases as that of the henny cock is giving us a clearer insight into the problem of secondary sexual characters, which can never be neglected by the breeder.*

A few words may be said of some experiments undertaken in order to investigate the characters of egg-colour and broodiness in poultry.† That we were unable to work out these characters in the way that we desired is due to circumstances brought about by the War. When they were planned there was a fair prospect of funds being found for the extension of the

* A full account of this case will be found in the following paper:—Genetic Studies in Poultry. III. Hen-feathered cocks, by R. C. Punnett and the late P. G. Bailey. *Journal of Genetics*, XI, 1921.

† Genetic Studies in Poultry. II. Inheritance of Egg-colour and Broodiness, by R. C. Punnett and the late P. G. Bailey. *Journal of Genetics*, X, 1920.

work necessary to complete it. War difficulties, however, forced us eventually to abandon the work before it was finished, and since the Armistice the funds available for this kind of research have not been sufficient to justify us in undertaking fresh experiments on these lines. Such results as we managed to obtain are not without interest, especially in view of the economic importance of the characters investigated. We began in the usual way, crossing birds of a brown-egg broody strain with birds of a white-egg non-broody strain. For the former we selected the Black Langshan, and for the latter the Brown Leghorn and the Gold Pencilled Hamburgh. In respect of egg-colour the first-cross hens were intermediate, though the tinted eggs they laid approximated more to the lighter than the darker kind of the parental breeds. In the F2 generation nearly 120 birds were tested, and great variation was found. Some laid white eggs, a few laid dark eggs resembling those of the Langshan, while the great majority laid tinted eggs. The grades of tint varied from nearly white up to full brown. For a given hen the grade was fairly constant, though it varied somewhat with the season, especially in the case of those birds laying the more deeply tinted eggs.

In its broad outlines the case was not unlike the weight case in poultry; viz., an intermediate F1 generation of fair uniformity, and an F2 generation showing a full range of variation, between and including the two parental forms (Fig. 6, p. 254). It is probable that here also we are dealing with several factors, each of which influences the tint of the egg; and our experiments have shown further that such factors are transmitted by the cock as well as by the hen. There is evidence also of the existence of a factor which inhibits pigmentation of the shell, and this factor would appear to be linked with the factor for black down. F1 birds from the Langshan and Brown Leghorn cross all have the dominant black down of the Langshan. In F2 the brown-striped down of the Leghorn reappears in a quarter of the chicks. Our testing results showed that the layers of white and nearly white eggs were relatively much more numerous among the pullets that hatch black in down than among those that hatched brown. This peculiar linking of characters, though familiar to plant breeders, has not often been met with among the higher animals. Probably this is because relatively little work has yet been done with birds and mammals. It is likely that, as our knowledge increases, these cases of linkage between characters will become more plentiful and it is not improbable

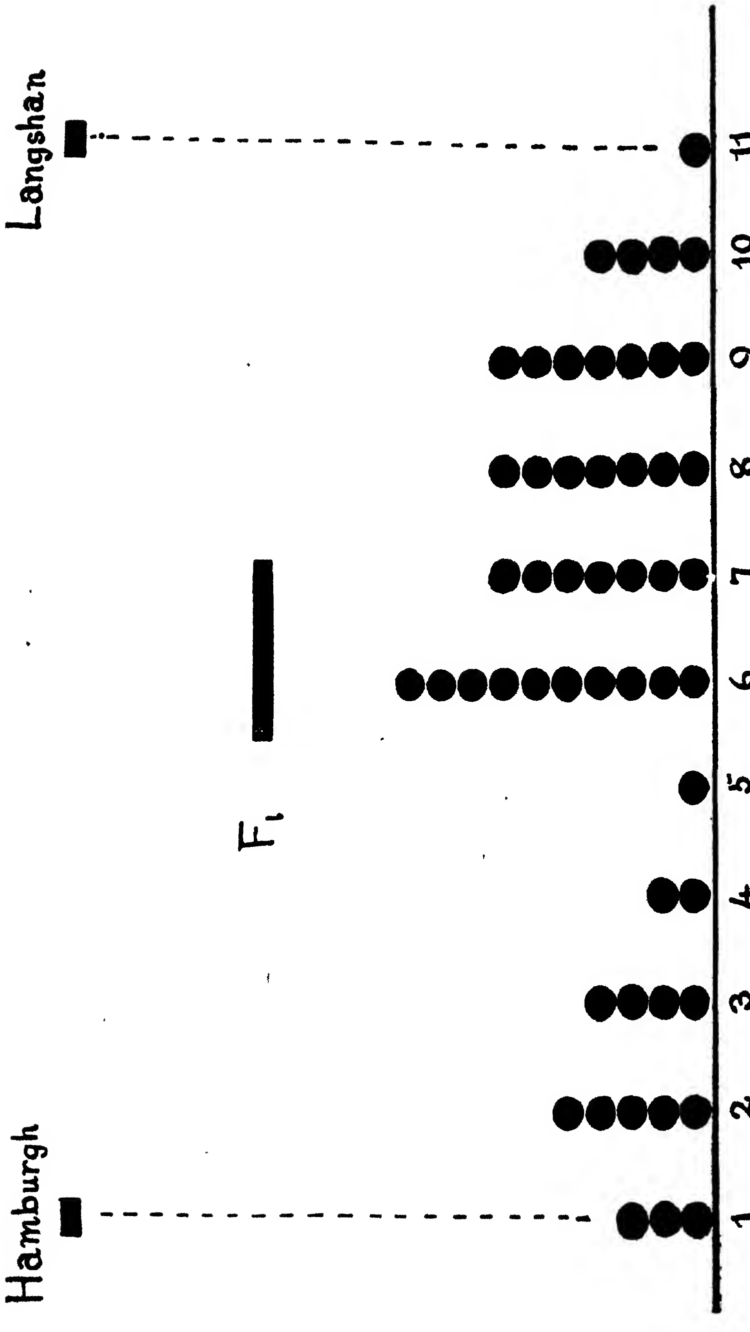

FIG. 8.—Illustrating the distribution of Egg Colour among the Pullets of an F2 generation of Langshan × Hamburgh. The numbers indicate the grades of tint from White (1) to Brown (11).

that some of them may turn out to have an economic value. For if a visible character, such as colour or pattern, were linked with such a character as higher milk yield, or more succulent mutton, breeding for these latter characters would be greatly facilitated.

Of our investigations into broodiness we can say little more than that they have shown the character to be a complex one. Hens vary greatly in this respect. Some go fully broody each year; others go broody occasionally and for a few days only; and all intermediate grades exist. Nevertheless our experience affords grounds for supposing that the character can be analysed and expressed in terms of definite factors, though it is clear that the experimental work demanded would be both long and tedious. For in broodiness, as in egg-colour, the case is complicated by the circumstances that the factors are carried and transmitted by the cock, though he neither goes broody nor lays eggs. And the cock can only be analysed by mating him with hens of known constitution, and testing the nature of his female progeny—which takes time.

Incidentally our experiments elicited a fact of some interest to poultry keepers. It is well known that the typically non-broody races lay white eggs, while the races that lay brown eggs belong to the broody section. It has been held that broodiness is necessarily correlated with the brown egg, and that it is not possible to establish a non-broody brown-egg race. Our experiments do not bear this out. It is true that the brown egg may be correlated with broodiness; nevertheless, the linkage between the factors concerned, if it exists, is not complete, for we succeeded in combining the full brown egg with the non-broody character. We do not doubt therefore that, by working on the right lines, a non-broody race laying brown eggs could be established.

As a by-product of the above investigation we obtained data on the inheritance of leg-feathering. For the Langshan is a breed with feathered legs, while the Leghorns and the Hamburghs are clean shanked. Our own data, taken in conjunction with those collected by other observers, have served to show that at any rate two factors are concerned in connection with this character. As with weight and egg-colour, the factors produce a cumulative effect, and a continuous series is to be found ranging from excessive development in birds pure for both factors, to absence of leg-feathering where neither factor is present. For a detailed discussion, however, the reader may be

referred to the original paper.* We have mentioned the case because it affords another example of what, at first sight, appears to be blended inheritance, though here again, as in the cases previously described, analysis has shown that the apparent blending is probably due to the cumulative effect of several definite factors.

Lastly, we may mention that in the course of our work we have gathered much information that is likely to prove of value for specific purposes. Our experiments with rabbits, for example, though designed primarily to study the inheritance of weight and certain patterns, have been used, as far as possible, to analyse the factors upon which the colour of the coat depends. In connection with the establishment of the natural rabbit fur industry, which is beginning to make progress, the information has already been of service to the utility breeder; nor can it be doubted that, as our knowledge extends, it will prove of greater value in the future.

But after all the main object of the Cambridge work is the elucidation of the principles that underlie the phenomena of heredity. Once these have been revealed by research the application can be left to those who will derive profit from it. Of one thing, however, we feel sure, and that is that the breeder who masters the conceptions implied in the factorial theory of heredity will not only find in them a sure guide to practice, but will derive greater pleasure in the exercise of his craft as he sees fact after fact relating themselves to one another, and falling into place in a definite and orderly scheme.

(Concluded.)

* Genetic Studies in Poultry. I. Inheritance of Leg-feathering, by R. C. Punnett and the late P. G. Bailey. *Journal of Genetics*, VII, 1918.

MOSAIC DISEASE OF POTATOES.

A. D. COTTON.
Mycologist to the Ministry of Agriculture and Fisheries.

ALTHOUGH the disorder of potatoes termed Mosaic has only recently been regarded as a specific disease, there is evidence that it has been in existence for many years. At the present time it is found in potato crops all over Europe and in North America; and since the disease is distributed by means of the seed tubers it probably occurs wherever the potato is grown. Potato Mosaic has, up to the present, been studied more thoroughly in the United States than elsewhere, and the scientific information available is almost entirely derived from investigations carried out in that country.

Potato Mosaic in Britain.—Owing to the fact that Mosaic symptoms have not hitherto been regarded as those of an actual disease, it is not surprising to find that no general or popular name for the disorder exists. It is clear, however, that the terms " miffy " and " miffiness " in common use in certain districts are usually, if not always, applied to potato plants affected with Mosaic, and that Mosaic symptoms are more or less known to observant growers. There are Scottish growers who can recollect having observed the characteristic mottling of Mosaic for forty years, and in all probability the disease has been general in Britain for a much longer period. It is also clear that what is spoken of in the south of England as " deterioration " in potatoes is at times only the result of a general attack of Mosaic disease.

The disease occurs in all parts of the British Isles, though in varying intensity, and is frequently responsible for light crops on farms, and, to an even greater extent, in gardens and allotments. For this reason growers are advised to make themselves acquainted with the appearance of Mosaic and with the extremely important discoveries with regard to its contagious nature (see p. 338), since remedial measures can only be adopted after the disease has become fully recognised and the facts as to its method of spread appreciated.

Mosaic Diseases in General.—Before describing the symptoms of Potato Mosaic it may be advisable to record what is known of Mosaic diseases in general. They constitute a group or class of diseases of an infectious nature, this being proved by the fact that if the sap of a diseased plant is inocu-

lated into a healthy one the disease is reproduced either immediately or in the progeny of the inoculated plant. The causal agent is not known, but it has been shown that fungi are responsible and bacteria have not been found. It is clear, however, that the infective principle or virus is present in the cell-sap, but the nature of this virus has so far eluded the search of the highest powers of the microscope. Whatever the infective principle may be it is in some cases so potent that even the most minute quantities of infected sap conveyed by small sucking insects such as aphides are sufficient to transmit the disease. Among other important crops in which infectious Mosaic disease occurs are those of tomatoes, beans, cucumbers, sugar-beet, maize, sugar-cane and tobacco.

In some cases (*e.g.*, dwarf beans) Mosaic is transmitted from season to season through the seed, but in others (*e.g.*, tobacco) this does not appear to be the case. In Potato Mosaic it is carried by means of the tubers, and thus. like Potato Leaf Curl, it may, in a loose sense, be said to be inherited.

Description of Potato Mosaic.—The symptoms of the disease vary somewhat, both in different varieties and in different parts of the country, but the following account will probably suffice to indicate the features by which Mosaic may be recognised.

The most obvious and distinctive character, and the one from which the disease takes its name, is the mottling of the foliage. The individual leaflets, instead of presenting a normal, uniformly green appearance, are faintly mottled or mosaicked in varying shades of green.* Usually coupled with the mottling is a crinkling of the foliage—a waviness in the outline of the leaflets and other indications that the leaves are not normal. In some varieties and in severe attacks this crinkling or puckering becomes very marked. Typical Potato Mosaic may nearly always be seen (in early summer especially) in the very susceptible varieties mentioned on page 339. Under certain conditions, and especially if it only develops late in the season, this mottling of the foliage may be very conspicuous, but the plants otherwise appear healthy and may produce a good or fairly good crop of tubers.

In more severe attacks other symptoms are apparent. A dwarfing tendency is very frequently manifested, and when

* It should be noted that this mottling is a very faint one and quite different from the bright yellow spots found not infrequently in certain early varieties. The latter is a variegation and not Mosaic or any form of disease.

this takes place there is a marked reduction in the yield. In extreme cases the growth of the plants may be completely stunted, and when this stage has been reached the crop is reduced to practically nil.

An important point to be noted in recognising the disease is that, though mottled foliage is one of the principal diagnostic characters and is usually very marked and conspicuous, this is not invariably the case. The mottling appears to be modified materially by climatic conditions. In cooler and damper regions, typically mottled foliage may be found throughout the entire season, but in the hotter and drier parts of the country this feature, though quite apparent earlier in the season, may become much less marked later and may even disappear entirely. The crinkling of the foliage, however, remains.* This is comparable with observations made in the drier States of America, where, though the yield is very much reduced, the mottling symptoms are completely suppressed. It has been proved experimentally that this is a climatic effect. Plants of the same stock of seed were planted in Maine and Colorado. Mottling occurred in Maine but none developed in Colorado. That the stock did not lose the disease but was still infected was shown by the fact that when the southern-grown crop was returned to its northern station, the mottling reappeared. It would also seem from certain experiments that, though typical mottling is more *conspicuous* in the north, the *effect* of the disease may be more serious in the hotter parts of the country.

Intensity of the Disease and Effect on Yield.—As will be gathered from the above description of symptoms, the intensity of the attack varies greatly. In general the effects of the Mosaic disease are more severely felt in the drier and warmer parts of the country, and, as indicated in the preceding paragraph, climatic conditions appear to be the main (though perhaps not the only) factors governing the degree of intensity exhibited. Owing to Mosaic disease having only recently been recognised in England, few precise records exist as to its effect on the yield. It is probable that in most parts of Scotland and in the cooler and damper parts of England and Wales the diminished yield due to the disease is relatively slight. In the warmer and drier parts of England, however,

* The mottling symptoms are more clearly seen on a dull day or when a shade is thrown over the plant. A white sheet of paper held under the leaf also assists in throwing the mottling into relief.

there is evidence that the reduction is more marked. Under average field conditions, affected plants appear to show a decrease of 15 to 35 per cent. in yield as compared with healthy plants. It is true that only a certain number of plants in the crop are attacked, but even at a modérate estimate the aggregate loss due to Mosaic in the midland, southern and eastern counties of England must be very considerable. In gardens and allotments where local or home-saved seed is used, a very dwarf form of the disease frequently occurs, and the losses are much more serious.

Mosaic is particularly troublesome to the potato breeder. In certain districts of England it persistently attacks seedlings in its most intense form, and may at times practically kill out first year plants.

Transmission of the Disease.—It has been clearly established that Potato Mosaic is carried from season to season in the seed tuber, and that diseased plants do not recover, their progeny reproducing the disease each successive year.* It is also known that Potato Mosaic is infectious, inasmuch as healthy plants, if surrounded by, or grown in proximity to, diseased ones, are liable to contract the disease and show it the following season in their progeny.

The method by which infection of healthy plants takes place in nature is recorded in two papers recently published in America.† It was discovered that, as in the case of Tobacco Mosaic, the disease virus was conveyed by Aphides ("green-fly") which fed on affected plants, the particular species responsible in the State of Maine being chiefly the Spinach Aphis (*Myzus persicæ*). Experiments proving this were carried out both in the greenhouse and in insect-proof cages in the open. If Aphides which had been sucking the juice of diseased plants were introduced into the cages, infection followed; if Aphides from healthy plants were introduced, no infection followed. Where infection took place early in the season, the mottling of the foliage developed during the same season, but when the plants were inoculated later, the disease

* As a rule the whole progeny of a newly-infected plant shows the disease the following season, but occasionally, perhaps in cases of late infection, a few tubers escape and give rise to healthy plants.

† Investigations on the Mosaic Disease of the Irish Potato, by E. S. Schultz, D. Folsom, F. M. Hildebrandt, and L. A. Hawkins. *Journ. Agr. Research* XVII, pp. 247-273, 1919.

Transmission of the Mosaic Disease of Irish Potatoes, by E. S. Schultz, and D. Folsom. Loc. cit., XIX, pp. 315-337, 1920.

only showed itself in the progeny the following year. On the negative side it may be noted that no infection followed when biting insects, such as Flea-beetles or Colorado Beetles, were used; neither was there any evidence that the disease was contracted from the soil.

Susceptibility of Varieties.—During 1920 the Ministry undertook a preliminary survey of the distribution and intensity of Potato Mosaic in England, and observations were also made on the relative susceptibility of the different varieties. It would be premature as yet to generalize from the information obtained, but the following may be taken as holding good. It was found that, though the disease occurred to a limited extent in almost all varieties, both early and main-crop, there was a very marked variation in the percentage of infection commonly present as well as in the intensity of the attack.

Under field conditions four varieties stood out above others as being specially susceptible. These were Golden Wonder, Langworthy, Burnhouse Beauty and Tinwald Perfection. In these varieties, affected plants to the extent of 30 per cent. and upwards of the crop were commonly found in all parts of the country, whilst in some fields 75 per cent. or even 100 per cent. showed the disease. It should be noted that the first two varieties mentioned, although of good quality, are well known to be particularly light croppers; and there can be little doubt that this peculiarity is due to the very general presence of Mosaic disease. Other varieties which showed the disease in some quantity were Arran Chief, The Ally, Dargill Early, and King Edward. It is obvious that these badly-infected stocks should, if possible, be eliminated and cleaner stocks worked up.

Measures of Control.—The two points to be clearly grasped are:—

(a) Infected plants do not recover, but carry the disease from season to season by means of the tubers. (b) By reason of aphis attacks the disease is transferred from infected plants to healthy ones and asserts itself more prominently the following season.

The following preventive methods should therefore be observed:—

(1) Seed tubers should not be saved from diseased plants, nor from plots or fields where the disease is present in any quantity;

(2) In the south, where the disease not only occurs in more severe form but is apparently more liable to spread (perhaps owing to earlier and more extensive attacks of aphides), extra care should be taken as to "seed." Where the disease occurs, no "seed" should be saved, but fresh "seed" should be obtained from a good district in the north of England or from Scotland or Ireland.

(3) Where Mosaic is persistently troublesome, varieties particularly subject to it should not be grown.

(4) Early rogueing is of some value, but under ordinary farm or garden conditions the amount of success obtained is not commensurate with the cost. In the case of new varieties or seedlings the matter is different and special methods are warranted. If rogueing is carried out with extreme care and thoroughness, and if aphis attacks are prevented by spraying with a good insecticide (such as nicotine and soft soap), complete success should be possible. In the case of valuable crosses, the use of aphis-proof cages might be considered.

(5) Those who grow for wholesale "seed" purposes should remember that, though the effect of Mosaic may be comparatively slight in the north, it is often more severe in the south, and as the disease becomes known the demand for Mosaic-free "seed" will increase. Disease-free stocks should be therefore retained and worked up for "seed" purposes. In the case of new varieties, it may pay to isolate these from other stocks, rogue carefully, and even spray with soft soap and nicotine in the summer months.

LIMING:

WITH SPECIAL REFERENCE TO THE USES OF GROUND LIMESTONE.

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"LIME, when laid on in large quantities, has in this country a wonderful effect. . . . From my own experience I know that no good crop can be expected under two hundred bushels of lime per acre. . . . Upon peaty ground at least double the quantity of lime may be used. Indeed, as I have before mentioned, you can scarce lay on too much upon such land."*

So wrote Thomas Johnes of Hafod, a distinguished Cardiganshire landlord, whose field expriments and various other investigations had a very marked beneficial influence upon the practice of farming in Mid-Wales at the commencement of the nineteenth century.

Down to the middle of last century farmers relied almost entirely upon lime and dung for maintaining and improving soil fertility. The latter half of the century, however, witnessed a great decline in the use of lime. This was due to several causes :—

(1) Extensive liming and under-manuring often resulted in soil exhaustion.

(2) The erroneous belief that the use of artificial manures did away with the need for liming.

(3) Shortage of farming capital due to the agricultural depression of the 'nineties.

(4) The increasing scarcity and cost of labour.

During the last 13 years the writer has analysed a large number of soil samples obtained from various districts in Mid and South Wales. The results of the analyses, considered in conjunction with field observations, appear to support strongly the substantial truth of Thomas Johnes's conclusions. The evidence in support of the view that the practice of liming in Mid and South Wales should become much more general may be briefly stated as follows :—

* "A Cardiganshire Landlord's Advice to his Tenants," by Thomas Johnes, Esquire, of Hafod, 1800.

(1) The great number of soil samples which the writer has analysed in connection with the advisory work of the Agricultural Department of the University College of Wales were, with very few exceptions, practically devoid of carbonates. Worse than this, a very high proportion of the samples were found to be distinctly sour.

(2) In practically every case where farmers, acting upon the recommendation given in the reports of these analyses, applied lime there followed a marked increase in crops.

(3) In several districts the "Finger and Toe" disease of the swede and turnip crop is very prevalent.

A striking example of this trouble is given by a farm in South Wales *situated within three miles of a limestone quarry and kiln.* This farm has suffered severe losses of crops due to the ravages of "Finger and Toe." The presence of an easily accessible source of lime in this particular instance brings out vividly the decline in the old custom of liming. A sample of the soil from one of the affected fields on this farm gave the following results when tested in the laboratory:—

Hygroscopic moisture	2·13 per cent.
Loss on ignition	8·03 " "
Carbonate	Nil.
Lime requirement (calculated as $CaCO_3$) ...	·27 " "
Action on litmus	Strongly acidic.

(4) In several cases where land has been laid down to grass, it has been observed that the clovers have more or less failed. Some of these cases have been specially investigated and have provided data of some interest as regards the probable cause of failure. The following example may be regarded as typical of such cases:—

A farmer made two unsuccessful attempts to lay a particular field down to grass. The soil was regarded as a very fertile loam and was apparently uniform in every respect throughout the field; although the clovers flourished satisfactorily in parts of the field there were isolated areas where they had failed completely. Samples of the soil were taken from each of the "failure areas" and also from the adjoining land on which the clovers thrived. Both sets of samples were analysed. The results showed that in mechanical and chemical composition all samples were alike except that those obtained from the "failure areas" were more acidic and had a higher lime requirement. This is shown in the following table:—

	Clover Areas. Average for 4 Samples.	*Failure Areas. Average for 5 Samples.*
Carbonate	Nil.	Nil.
Action on litmus	Slightly acidic.	Strongly acidic.
Lime requirement (calculated as $CaCO_3$)	0·078 per cent.	0·160 per cent.

In view of the obvious necessity for increased liming, and of the fact that "lime" for agricultural purposes may be obtained in at least three forms, viz., burned lime, ground quicklime and ground limestone, it is highly important that farmers should be aware of the conditions under which these various forms of lime may be most profitably used. It is the special object of this article to draw attention to some of the circumstances which may influence the value of ground limestone as a fertilizer. At present there are but relatively few farmers who view ground limestone with much favour. There appear to be several reasons for this:—

(1) Excessive claims made on its behalf have led to the application of dressings much too small to produce appreciable results.

(2) Its price has often been proportionate to the excessive claims.

(3) Variability as regards both composition and degree of fineness. This may be exemplified by the following analyses of samples received at the college laboratory:—

		Ground Limestone No. 1.	*Ground Limestone No. 2.*
	Percentage calcium carbonate ...	94·25	53·11
* Percentage fineness of particles	Below $\frac{1}{100}$ in. diameter	14·92	3·14
	Between $\frac{1}{100}$ in. and $\frac{1}{60}$ in. diameter	73·03	37·65
	„ $\frac{1}{60}$ in. „ $\frac{1}{25}$ in. „	10·80	35·09
	Above $\frac{1}{25}$ in. diameter	1·25	24·12

(4) Farmers have failed to realise its limitations. Limestone is very efficient in correcting sourness and in assisting chemical and bacterial actions, but is very inferior to burned lime for improving the texture of heavy clay soils. It often happens that a farmer's prejudice against ground limestone rests upon failure to secure any benefits from the application of only 4 or 5 cwt. per acre on stiff clay soils.

Among the reasons which may be advanced in favour of using ground limestone, the following may be enumerated:—

* See "Selection of Fertilizers," by J. J. Griffith, University College of Wales, 1915.

(1) High cost of fuel, especially in the case of limestone quarries situated away from coal areas.

(2) In districts where limestone is used for road repairs, definite testimony has been borne to its value by farmers who, recognising the superiority of that kind of road scrapings and ditch cleanings, have made a practice of using them.

(3) It is possible to secure much finer grinding than was practicable 15 or 20 years ago.

(4) During recent years laboratory methods for ascertaining the lime requirements of soils have been much improved. Now it is possible to give the farmer reliable guidance in this connection, so that he may know the minimum quantity of limestone needed to meet the requirements of his particular soil.

(5) In the case of soils with low lime requirement it is easier to apply small dressings of ground limestone than of lump lime.

Last year the writer conducted a pot experiment to ascertain the influence of degree of fineness upon the efficiency of ground limestone. Trefoil (*Medicago lupulina*) was chosen as the crop to be grown, because Wales is mainly a grassland country, and because the success of grassland farming is to be measured largely by the farmer's success in keeping up a high proportion of leguminous plants in the herbage. Further, Professor Lloyd Williams furnished the information that, under Welsh conditions of soil and climate, of the leguminous lime-loving plants, trefoil was particularly sensitive to the action of lime.

The carboniferous limestone chosen for the experiment was analysed and found to contain:—

	Percentage.
Moisture	·23
Calcium Carbonate	97·16
Magnesium Carbonate	·59
Iron and Aluminium oxides	·25
Matter insoluble in acid	1·32

The soil used in the pots was fairly typical of the sedentary soils on the Ordovician formation in Mid Wales. The soil was found to be acidic in its action upon litmus paper. Its lime-requirement, ascertained by shaking with a standard solution of calcium bicarbonate, was found to be equivalent to 1.25 per cent. of calcium carbonate (approximately equal to 25 cwt. per acre). Its mechanical and chemical composition is indicated in the subjoined table:—

(a) *Mechanical Composition.*

	Percentage.
Moisture	2·7
Loss on ignition ...	10·6
Gravel	17·9
Coarse Sand	15·5
Fine Sand	15·0
Coarse Silt	15·4
Fine Silt	16·6
Clay	4·4

(b) *Chemical Composition.*

	Percentage.
Nitrogen	·31
Total Phosphoric Acid (P_2O_5)	·089
Citric-soluble Phosphoric Acid	·006
Total Potash (K_2O) ...	·78
Citric-soluble Potash ...	·05
Total Lime (CaO) ...	·23
Total Magnesia (MgO)	·20
Carbonate	Nil.

The limestone was ground in a mortar and separated by sieves into four fractions of the degree of fineness indicated below :—

Fraction A.	Particles below $\frac{1}{8}$ in.	and above $\frac{1}{12}$ in.	diameter.*
Fraction B.	,, ,, $\frac{1}{12}$ in.	,, ,, $\frac{1}{25}$ in.	,,
Fraction C.	,, ,, $\frac{1}{25}$ in.	,, ,, $\frac{1}{100}$ in.	,,
Fraction D.	,, ,, $\frac{1}{100}$ in.		

The pots were filled with soil and seed was sown on May 15th, 1920. Pots 1, 2 and 3 for control received no limestone, while the soil in Pots 4 to 11 inclusive received an admixture of 0.3 per cent. ground limestone (approximately equivalent to 3 tons per acre). No manure was added to any of the pots. The treatment is indicated in greater detail in the following table :—

Pots 1, 2 and 3	No limestone.	
Pots 4 and 5 ...	0·3 per cent. of limestone, particles	$\frac{1}{8}$ in. to $\frac{1}{12}$ in.
Pots 6 and 7 ...	,, ,, ,, ,, ,,	$\frac{1}{12}$ in. ,, $\frac{1}{25}$ in.
Pots 8 and 9 ...	,, ,, ,, ,, ,,	$\frac{1}{25}$ in. ,, $\frac{1}{100}$ in.
Pots 10 and 11	,, ,, ,, ,, ,,	below $\frac{1}{100}$ in.

Eighty seeds of trefoil were sown in each pot. By May 23rd the seedlings appeared in all pots. They did not, however, thrive in any pot. In fact they were of a poor colour, appeared to be in a very critical state, and made but very slight progress up to June 10th. At this date, however, the plants in pots 10 and 11 appeared to have greatly improved in colour and were making headway. The plants in the other pots did not improve much for another fortnight. On June 28th the plants were thinned down to 40 individuals to each pot.

* That it is practicable to grind limestone so that the greater part of it would pass through a 100 mesh to inch sieve is shown by the following results recently obtained by the writer in examining a sample of ground limestone :—

Particles $\frac{1}{8}$ in. to $\frac{1}{12}$ in.	... ...	0·14 per cent.
,, $\frac{1}{12}$ in. ,, $\frac{1}{25}$ in.	... ...	1·63 ,,
,, $\frac{1}{25}$ in. ,, $\frac{1}{100}$ in.	... ...	7·15 ,,
,, below $\frac{1}{100}$ in.	... ...	91·08 ,,

On July 31st the crop was cut and subsequently air-dried and weighed. The results are shown in the following table :—

Treatment Limestone.	Nil.			Particles $\frac{1}{8}$ in.—$\frac{1}{12}$ in.		Particles $\frac{1}{12}$ in.—$\frac{1}{25}$ in.		Particles $\frac{1}{25}$ in.—$\frac{1}{100}$ in.		Particles below $\frac{1}{100}$ in.	
No. of Pots	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Wt. of air-dried crop in grms. -	2·6 ;	2·5;	2·5;	3 3;	3·0;	3·6;	3·2;	4·7;	4·1;	9·6;	11·0.

As indicated in the illustration and figures given above, the ground limestone of a degree of fineness below 1/100 in. benefited the crop to a remarkable extent. With 1/25 in. to 1/100 in. the benefit was slight, while in the case of the two coarsest grades the effect was almost inappreciable. The pots were allowed to remain without any further treatment to provide a second crop.

The second crop of trefoil was cut on November 29th. The results are given below :—

	Control.			Particles $\frac{1}{8}$ in.—$\frac{1}{12}$ in.		Particles $\frac{1}{12}$ in.—$\frac{1}{25}$ in.		Particles $\frac{1}{25}$ in.—$\frac{1}{100}$ in.		Particles below $\frac{1}{100}$ in.	
No. of Pots	1.	2.	3.	4	5.	6	7.	8.	9.	10.	11.
Wt. of air-dried crop in grms. -	1·0;	1·2;	1·2;	1·3;	1·4;	1·3;	1·8;	1·5;	1·7;	23 2 ,	24·3.

The results given above indicate very clearly that the trefoil did not respond to any appreciable extent to ground limestone which could not pass through the 1/100 in. mesh sieve. In the case of the finest grade (below 1/100 in.) the effect upon the crop was very marked. It should be observed that the superiority of the finest grade was even more striking with the second crop than with the first. It is thus evident that particles above 1/100 in. not only failed to have any appreciable immediate effect upon growth, but also did not succeed in assisting the crop even several months after application. Another feature of the experiment, of considerable interest from the practical farmer's point of view, is the large number of plants which perished during the first few weeks after germination, both in the control pots and in all the pots to which the grades of limestone above 1/100 in. were applied. In the case

FIG. 1.—Showing the first crop of Trefoil, on 19th July, 1920

of pots 10 and 11, *i.e.*, those treated with limestone below 1/100 in., very few plants died.

Several American experiments* have been conducted in order to ascertain the degree of fineness to which limestone should be ground. The results obtained regarding the desirable degree of fineness vary from 1/50 in. to 1/100 in.

In certain circumstances coarsely ground limestone might meet crop requirements. There are conditions, however, in farming practice which would appear to make the finest possible grinding advisable. A high degree of fineness facilitates thorough incorporation with the soil. This is of greater importance with the application of small quantities than it is with heavy dressings, and ground limestone is often applied in relatively small dressings. Again, the trefoil pot experiment, referred to above, shows that during the season of application the coarser particles may have but little if any beneficial effect upon the crop. There are occasions when it is particularly important to supply lime in such form as will assist the plant during the season of application. In many cases it would be applied at that point in the rotation when the grass and clover seeds are sown. In such a case the degree of fineness of the limestone, and therefore its availability for the plant during the first year, which is often a critical period, might decide whether the laying of the land down to grass was a success or failure.

Reference has already been made to the fact that in many districts farmers have lost faith in ground limestone on account of its "failures." Most of these "failures," however, can be explained readily as arising from the *improper* use of ground limestone. For example, in the hilly districts of Wales many cases have come under observations where *unsuccessful* attempts have been made to improve pasture land by the application of 5 or 6 cwt. per acre of ground limestone. The distinctive feature of the soils in the cases examined were (*a*) richness in organic matter, (*b*) a high degree of acidity, and (*c*) a particularly high lime requirement.

During the years 1914-15 the Agricultural Department of this College carried out an experiment† to ascertain the most suitable manurial treatment for upland pastures. The report states that

*Lyon, Fippin and Buckmann, "Soils, their Properties and Management," p. 540. Maryland Agricultural Experiment Station, Bulletin No. 193, p. 45. Pennsylvania Experiment Station, Bulletin No. 149, p. 21. Agricultural Experiment Station of the Rhode Island State College. Bulletin No. 180.

† "The Improvement of Upland Pastures," by Jones and Stapledon.

"by the second year the limed plot shows practically identical results with the unmanured." The writer was requested to sample the soil of the various plots in order to ascertain their lime requirements. As indicated in the table given below, soil samples were taken from:—(1) Fescue pasture areas, (2) areas containing a high proportion of white clover, (3) *Molinia* pasture areas, (4) peaty layer 1 in. to 2 in. depth covering the fescue areas.

Table showing lime requirement of soil from various plots.

No. of Sample.	Description of Sample.	Manurial treatment of plot.	Lime requirements calculated as $CaCO_3$ percent.*
1	Sample of the peaty surface of the fescue area	B. slag	0·974
2	Sample of soil, fescue area, Plot I	" "	0·430
3	" " " " " " II	" " muriate of potash	0·420
4	" " " " " " III	Lime, superphosphate, muriate	0·460
5	" " " " " " IV	Lime, superphosphate	0·430
6	" " " " " " V	Lime, 10 cwt. per acre	0·390
7	" " " " " " VI	No manure ...	0·460
8	" " " clover " " I	—	0·295
9	" " " Molinia " " IV	—	1·065
10	" " " bog land adjoining plots	—	0·735

The figures given in the table show that the lime-requirement of the soil of the Fescue pasture was very high (samples 2 to 7) and that it was still higher in the case of the *Molinia* pasture (sample 9). In the isolated spots where the clovers flourished the lime requirement was much lower (sample 8). The lime-requirement of the surface peaty layer overlying the Fescue area (sample 1) was so high that if a small dressing of lime were applied it would be used up before it reached the underlying portion of the soil. Further, the lime-requirement figures in general were so high that it could not reasonably be expected that a small dressing of lime would lead to much improvement. The nature of the soil on these plots was fairly representative of hill soils in Mid Wales. It is, therefore, not surprising that small dressings of ground limestone applied to upland pastures have often been "failures." This experiment was conducted in the district of which Thomas Johnes wrote, and it explains the

* 1 per cent. lime requirement is approximately equivalent to 1 ton per acre for a soil 9 in. deep.

truth of his statement that "lime, when laid on in large quantities, has in this country a wonderful effect."

General Conclusions.

(1) Liming as a general farm practice must receive more attention if soil fertility is to be raised and food production increased.

(2) Great losses must be taking place in connection with the pasture land of the country because soils are deficient in lime when grass and clover seeds are sown.

(3) In view of both the increased cost of fuel and the improvements which have been effected in the construction of pulverizers and crushers, ground limestone may under many circumstances be advantageously taken as a substitute for burned lime.

(4) A demand for ground limestone may lead to the opening up of disused quarries outside coal areas, and may thus establish new centres of distribution.

(5) There appear to be various reasons why expenditure on ground limestone has often been unremunerative in the past, viz.:—

(*a*) Coarseness of grinding.

(*b*) More impure limestone used for its manufacture than was the case for the production of burned lime.

(*c*) The smallness of the dressings which have often been applied to soils which needed fairly heavy liming.

(*d*) The exorbitant prices which have on occasions been charged for it.

REPORT ON POTATO TRIALS, 1920.

Introduction.—Official statistics for 1920 show that the acreage of potatoes in England and Wales was 544,615 acres, with a total yield of 3,151,000 tons. These statistics relate only to holdings of more than 1 acre in extent, so that the true acreage of potatoes in the country must be considerably in excess of this figure, as potatoes are grown on most small holdings and allotments, and in private gardens.

The total value of this crop to the Nation directly and in terms of money cannot be less than £25,000,000, so that the industry is of great economic importance. Moreover, the food value of the crop is unquestioned. Its importance, as shown by the above figures, is such as to justify, and in fact necessitate, the carrying out of experiments and demonstrations to throw more light on many of the more complex matters of cultivation; to discover and demonstrate to the public the superior cropping capacity of new varieties of potatoes on particular types of soil; to demonstrate the value of a complete manure such as that which gave the most satisfactory results in the trials of potatoes carried out by the Irish Department of Agriculture in previous years; and to increase supplies of those varieties possessing great powers of resistance to the many diseases. The most important problem affecting potatoes with which the Ministry is at present faced is the safeguarding of the crop against Wart Disease by the growing of immune varieties on infected land, and therefore the varieties selected for these demonstrations were mainly those sorts which have proved immune to Wart Disease. The trials should provide figures showing the most profitable of these to grow, and where a satisfactory yield is obtained, these trials serve a useful propaganda purpose in connection with the control of this disease.

The growing of the very early varieties for lifting green has now become an important industry to many growers, and especially to those with a limited amount of land situated near large centres of population, so that trials to compare the cropping capacities of some of the early immune varieties with those of such popular susceptible varieties as "Epicure," "May Queen," and "Ninetyfold" were needed. The Ministry's scheme was prepared with due consideration to these points, and was circulated to County Horticultural Committees, with a request that they would carry out trials of

potatoes in their respective areas on the lines laid down in the scheme, the details of which were given as follows:—

Ministry's Scheme for Potato Demonstration Plots, 1920.— The main objects of the scheme are for the purposes of:—

(a) Finding out those varieties best suited to the different districts;

(b) Demonstrating approved methods of potato culture.

Wart Disease.—The Ministry requires the planting of immune varieties in those areas in which Wart Disease is known to be common and widespread, and in such areas Committees should use immune varieties only for their trials; whilst Committees in the "clean" districts should demonstrate the value of these immune varieties, and test their comparative merits with well-known susceptible kinds.

Supply of Seed.—The source of the seed potato influences the resultant crop to such an extent that all the seed should be obtained from the same source. It is advisable, therefore, that the seed, which will be Scotch Seed, should be purchased in bulk by the Ministry* and distributed to the various Committees. The seed potatoes will be invoiced at cost price to the Committees.

Quantity of Seed.—In carrying out these trials 14 lb. of each variety should be planted on land, which has been prepared according to the instructions given below.

Manures.—The land should receive farmyard manure at the rate of 15—20 tons per acre, and, preferably, to be applied in the drills at the time of planting; and artificials at the rate of:—

Superphosphate (26 per cent.)	4½ cwt. per acre.
Sulphate of Ammonia	1 " " "
Sulphate of Potash	1 " " "

Varieties.—The trials should be divided into two main sections:

Part 1.

Demonstration of the cropping powers of the well-known immune kinds such as Great Scott, Arran Comrade, Majestic, Kerr's Pink, Golden Wonder, Tinwald's Perfection and Favourite.

Part 2.

Early Variety Trials.—It is considered to be important to institute trials to test the earliness and cropping

* Later it was found to be more practicable to indicate sources of supply to County Committees.

qualities of certain early varieties. It must be realised that certain varieties are grown and marketed as earlies, which are not really earlies, if regarded from the point of view of maturity. "Epicure" is a good example of this. It is a variety which "bulks" quickly, and can be marketed early; yet, if judged by its date of maturity, it is a second early. The same remark applies to "Eclipse" and "Sir John Llewellyn."

It has been frequently stated that "King George," if well grown, will be ready for lifting quite as soon as "Epicure." Last season, in many districts, "Arran Comrade" matured earlier than "Epicure." It is, therefore, of the greatest importance that this problem of earliness should be tested in a thorough manner in all these districts where early potatoes are grown.

NOTE.—The Trials of Early Varieties are for the express purpose of comparing the earliness of some particular varieties. To obtain reliable results it is obvious that the seed of the many kinds must all come from the same source, be treated in a similar way, planted on the same date, and the crop given equal opportunities for development. It has been indicated before that it is not merely the determination of a date when the crop matures, but of a period when the crop may be profitably marketed. This is a point that should be well considered.

The instructions regarding supply of seed, manuring, &c., are the same as for the cropping trials.

Varieties as Controls for 1920.—Three of the leading well-known susceptible first earlies, "Duke of York," "Ninety-fold" and "Epicure," should be grown as controls with which the new varieties may be compared. These new varieties are Dargill Early, Arran Rose, King George, Nithsdale, Arran Comrade, Snowdrop.

Planting.—The time of planting will vary slightly according to the district. The trials should be planted at what is considered a suitable time for planting potatoes in the district. It is suggested that a distance of 26 inches between the drills and 12 inches between the sets should be adopted throughout all the trials. Any departure from these distances should be noted in the reports of the trials.

Reports.—It is suggested that Committee will prepare a full report of the trials for the benefit of farmers and allotment holders. The Ministry will also require a brief report drawn

up on certain definite lines in order that they may issue a summarised report of all the trials in the Country.

It was recognised that, although County Committees might arrange local schemes in their Counties, which would provide much valuable information to local potato growers, trials carried out on uniform lines in every County with seed from one source and with a uniform system of manuring, would supply this local information equally well and. in addition, further reliable information of national importance. It was for this reason that the scheme was prepared by the Ministry, and provisions made for the supply of seed.

Number of Centres.—The County Committees adopting the scheme made such arrangements to carry out the trials as were consistent with local conditions. Most Committees selected the Farm Institute—where one existed—for the site of the trials, but selected other centres in their areas as well, the total number of centres at which the trials were conducted being 455. In most cases the cost of the seed and manures alone had to be defrayed from public money, the land and labour being provided by private persons (farmers, small-holders and allotment-holders) in return for the crop produced. It is a pleasure to be able to record the satisfactory working of this plan, which had many points of great value; it allowed the trials to be carried out on commercial lines under the close attention of growers themselves, and relieved Committees of the responsibility of hiring or buying land. and from further financial transactions—a burden at all times to public bodies.

Finance.—As the trials were carried out in connection with the Educational policy of the Ministry, they were aided by the Department to the extent of two-thirds of the actual deficit cost. At the moment, details of the actual cost cannot be given.

Results.—Space does not permit of detailed results of every County trial being given in this Report. Most of these results have already been published locally, and it only remains for the Ministry to compile a report which will correctly interpret the sum total of the results from the many trials.

The correct interpretation of the results obtained from cropping trials is always a difficult matter because of errors which cannot be eliminated from field experiments. The value of such experiments depends upon the degree of confidence which can be attached to the results, *i.e.*, on the probability that similar results will be obtained when the trials are repeated. It follows,

therefore, that the more numerous the number of similar experiments the more convincing are the results.

It is true that *results* obtained at any one station or from several stations in any one County, might be unconvincing or even misleading; but some reliance can surely be placed on the results from carrying similar experiments out at 455 stations situated through England and Wales.

A review of the yields of each variety averaged for all the centres, shows at once how consistently and well the variety *Kerr's Pink* cropped, yielding the highest crop in 26 out of 35 English Counties carrying out trials. *Majestic* gave the largest yield in Essex, Hereford and Kent; *Arran Comrade* in Bucks, Lincolnshire (Lindsey), and Norfolk; *Great Scott* in Durham; *King George* in Cheshire, and *Epicure* in Berks. In Wales *Kerr's Pink* again did well, giving the largest yield in 4 Counties (Radnor, Monmouth, Montgomery and Anglesey); *Arran Comrade* in 3 Counties (Brecon, Cardigan and Carnarvon); *Great Scott* in 2 Counties (Carmarthen and Pembroke), and *Majestic* in Denbigh and Flint.

From the results summarised for the whole country, as shown below, it was found that the average yield of second early and maincrop varieties in these trials was 10 tons 6 cwt. per acre. This figure is greatly in excess of that for the estimated average yield of potatoes for the whole of England and Wales in 1920 (5 tons 16 cwt. per acre), and from this fact it would appear that provided better seed is used and the land adequately cultivated and manured, there is no reason why the yield per acre for the whole country should not be materially increased.

The following figures show the Average Yield of each Variety for all Centres:—

	Snowdrop.		Dargill Early.		Great Scott.		Majestic.		Kerr's Pink.	
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons	Cwt.	Tons.	Cwt.
Average Yield in England, 390 Centres	8	3	8	0	12	2	10	12	13	12
Average Yield in Wales, 65 Centres	6	13	7	7	10	2	9	11	11	8
Average Yield in England and Wales, 455 Centres...	7	16	7	17	11	13	10	7	13	2

	Golden Wonder.		Tinwald Perfection.		Favourite.		Arran Rose.		King George.	
	Tons.	Cwt.	Tons	Cwt.	Tons.	Cwt.	Tons.	Cwt	Tons.	Cwt.
Average Yield in England, 390 Centres	8	9	10	6	5	18	7	9	11	10
Average Yield in Wales, 65 Centres	8	1	8	18	5	17	7	1	11	5
Average Yield in England and Wales, 455 Centres...	8	7	10	0	5	18	7	7	11	9

	Nithsdale.	Duke of York.	Ninetyfold.	Epicure.	Arran Comrade.
	Tons. Cwt.	Tons. Cwt.	Tons. Cwt.	Tons. Cwt.	Tons. Cwt.
Average Yield in England, 390 Centres	10 0	8 16	8 14	11 11	11 10
Average Yield in Wales, 65 Centres	8 12	10 1	10 1	—	11 1
Average Yield in England and Wales, 455 Centres...	9 14	8 19	8 18	11 11	11 8

Table giving Summary of Average Yields per acre for England and Wales :—

First Earlies.

(a) Immunes.

	Tons.	cwt.
Dargill Early ...	7	17
Snowdrop ...	7	16
Arran Rose ...	7	7
Average ...	7	13

(b) Susceptibles.

	Tons.	cwt.
Epicure	11	11
Duke of York ...	8	19
Ninetyfold ...	8	18
Average ...	9	16

Second Earlies.

	Tons.	cwt.
Great Scott ...	11	13
King George ...	11	9
Arran Comrade...	11	8
Nithsdale ...	9	14
Average ...	11	1

Late and Main Crop.

	Tons.	cwt.
Kerr's Pink ...	13	2
Majestic ...	10	7
Tinwald Perfection	10	—
Golden Wonder...	8	7
Favourite ...	5	18
Average ...	9	11

From the table above it will be seen that so far as cropping powers are concerned, the first early immunes have considerable leeway to make up to equal the susceptible varieties which were used as controls. The final average for the three first early immunes is 2 tons 3 cwt. per acre behind the average of the three susceptibles, and *Dargill Early*, the highest cropping immune, is 3 tons 14 cwt. per acre behind Epicure, the highest cropping susceptible.

The second early varieties *Great Scott*, *King George* and *Arran Comrade* are very consistent with regard to their relative yields throughout the country. *Arran Comrade* has given heavy crops in *some* districts exceeding those of Kerr's Pink, as in Brecon, Carnarvon and Birmingham. *Nithsdale*, which is now regarded as a second early, has generally given considerably lower yields. It has, however, given heavy crops in the Northern Counties, the Midlands and in Wales.

Of the maincrop and late varieties, *Kerr's Pink* is at the top, and has given the heaviest average county crop, viz., 21 tons 9 cwt. per acre in Leicestershire. *Majestic* is a good second, with 19 tons 1 cwt. per acre in Hereford.

Unfortunately space will not permit of tables to be shown, to illustrate which of these varieties produce the higher proportion of ware potatoes in the crop.

Soil Influence.—An attempt has been made to show the effect of soil on the comparative cropping qualities of the many varieties.

Table comparing the Average Yields of the Varieties on Light, Medium and Heavy Soils:—

	Light. Per Acre.		*Medium.* Per Acre.		*Heavy.* Per Acre.	
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt
Kerr's Pink	13	18	13	14	13	2
Epicure	12	16	10	19	9	17
Great Scott	12	5	11	15	10	5
King George	11	11	11	15	10	4
Arran Comrade	11	10	11	11	10	10
Nithsdale	10	19	10	10	8	9
Tinwald Perfection ...	10	8	9	13	8	18
Majestic	10	7	10	13	8	9
Ninetyfold	9	10	9	19	7	14
Duke of York	9	1	10	5	8	—
Golden Wonder... ...	8	11	8	17	7	11
Snowdrop	8	9	7	—	6	19
Arran Rose	8	2	7	16	5	13
Dargill Early	8	—	7	18	6	10
Favourite	6	4	5	11	5	6
Average yield of all varieties	10	2	9	17	8	10

The best results were obtained on light loamy soils, the varieties averaging 10 tons 2 cwt. per acre as compared with 9 tons 17 cwt. on medium soil, a drop of only ¼-ton per acre. *Arran Comrade* and *Duke of York* in fact gave a slightly heavier yield, but *Epicure* gave approximately 2 tons per acre less.

On heavy soils, the reduction in yield is more marked, the average yield being 8½ tons per acre, or 1 ton 12 cwt. per acre less than on light soils. These figures are fairly consistent for most varieties, but *Epicure* appears to be more influenced by the texture of the soil than other kinds.

Speaking generally, most varieties have given the lowest yields on the heavy soils, while the heaviest aggregates have been obtained on light soils. The exceptions to this are *Duke of York*, *Ninetyfold* and *Golden Wonder* which have done best on medium soils. There is often difficulty in making recommendations for heavy soils, but the trials give some information on this point, *e.g.*, *Epicure* would appear to be the best susceptible early variety and *Snowdrop* the best immune; *Arran Comrade, Great*

Scott and *King George*, the best second earlies; and *Kerr's Pink*, *Tinwald Perfection* and *Majestic* are the best maincrop or late varieties.

On examining the average yields on light, medium and heavy soils for the whole Country, the following conclusions are indicated :—

(a) *Early Varieties.*—In the case of first earlies, the variety *Epicure* maintains its accredited position as the heaviest cropping early variety. It is only surpassed by *Kerr's Pink* when in competition on light soils with second earlies, maincrop and late varieties. On heavy soils it still retains first place, and apart from the fact that it is a susceptible variety, it shows great power of adaptability. *Duke of York* has cropped heavier than the immune varieties, and appears to be at its best on a medium soil. *Ninetyfold* also crops heavier on all soils than the early immunes. *Snowdrop* is the heaviest cropper amongst the immunes on light and heavy soils. *Dargill Early* takes the third place amongst the immunes on light soils, the first place on medium soils, and second place on heavy soils. *Arran Rose* takes second place amongst early immunes on light soils, second place on medium soils and third place on heavy soils.

(b) *Second Earlies.*—Amongst second earlies *Great Scott* holds the premier position, being the heaviest average cropper on light and medium soils, and only falls to the second place on heavy soils. *King George* takes the second place on light and medium soils and third place on heavy soils. *Arran Comrade* takes first place on heavy soils, with the very creditable average of 10 tons 10 cwt. per acre. It would appear to be the most suitable immune second early for a heavy soil, although *Great Scott* and *King George* closely follow it.

(c) *Main Crop and Late Varieties.*—Amongst these *Kerr's Pink* clearly demonstrates its superiority as a cropper and is on an average 1 ton 17 cwt. per acre ahead of all varieties on the three types of soil. It is of interest to note that this variety with a long season of growth gives the heaviest average on light soils. *Tinwald Perfection* takes second place on light and heavy soils but is beaten by *Majestic* on medium soils. *Golden Wonder* takes fourth place on all three types of soil. *Favourite* has done badly and has given the poorest results of any of the immunes.

Characteristics.—The addition of a section giving the characteristics of the varieties tested would increase the value of the report but would occupy too much space. Such information is given in the Supplement of the JOURNAL on the Cultivation, Composition and Diseases of the Potato, price 6d.

THE 1920 LINCOLN TRACTOR TRIALS.*

THOMPSON CLOSE, B. J. OWEN, B.Sc. (Eng.), and
H. G. RICHARDSON, M.A., B.Sc.

IT is to be regretted that the report of the judges of the Lincoln Tractor Trials of 1920† should not have been published until some six months after the event, and that now that it is finally given to the public the report should contain so few details of the performances of the machines taking part. We may recall that the conditions governing the trials conducted by the Royal Agricultural Society were drawn up under the influence of a principle the reverse of that which had been adopted by the Society of Motor Manufacturers and Traders in the previous year. At the earlier trials the performance of each machine had been recorded, there had been no prizes or awards, and those interested had been left to draw their own conclusions.

The R.A.S.E. determined to follow an old practice and award prizes. The awards were announced at the conclusion of the trials, but it was expected that the basis of the awards would in due course be disclosed in the form of a record of the individual performances of the competing machines. We have previously expressed our grave doubts as to the wisdom of awarding prizes or instituting an order of merit in such cases, and we venture to think that the present report will not convert anyone to a belief in the value of prizes. We may go further and assert that the public interested in agricultural tractors have a moral right to be furnished with the recorded performances of tractors competing in public trials. Apart from the importance to farmers and manufacturers of knowing exactly the considerations which influenced the judges in awarding a prize, it should be possible for anyone to compare the actual performances of each tractor and further to compare the year's records with those of preceding years.

The only details of performance disclosed are contained in Table III under the heads of:—

Time in hours per acre.
Fuel in gallons per acre.
Wages in pence per acre.
Fuel cost in pence per acre.

* In continuation of "Notes on the Lincoln Tractor Trials, 1920," *Journal*, Nov., 1920, p. 714.

† Published by the Royal Agricultural Society of England, price 7s. 6d.

These give the minimum, the average of the five lowest, and the maximum in each class for heavy and light land, and under the head "Total cost of labour and fuel per acre" give the minimum and the average for the whole class. A note warns us that "the figures for minimum time and minimum fuel consumption per acre do not necessarily apply to the same tractor" and that "the same is the case for the maxima," and we are left in complete doubt as to the bearing of these figures on the awards.

If the object were to institute a comparison between classes of machines these figures would doubtless be of value, although we may express a doubt whether the classification adopted for the purposes of this competition has the highest scientific value.

It appears that in Class I (two-furrow tractor) the minimum time to plough an acre on light land was 1.58 hours, the maximum 2.33 hours; on heavy land 1.75 hours and 2.61 hours, respectively. In Class II (three-furrow tractor) the times were, for light land, minimum, 1.09 hours, and maximum 1.99 hours; for heavy land, 1.30 hours and 4.00 hours respectively. In Class VII (motor ploughs) on light land, minimum 1.46 hours and maximum 2.42 hours; on heavy land 1.30 hours and 3.22 hours respectively.

The consumption of fuel in gallons per acre was as follows:—

		Min.	Max.
Class I.—Two-furrow tractors, light land	...	2·63	5·41
heavy "	...	3·42	5·51
Class II.—Three-furrow tractors, light land	...	2·06	4·12
heavy "	...	2·96	6·51
Class VII.—Motor ploughs, light land	...	2·21	4·48
heavy "	...	2·27	6·21

On the basis of 18d. per hour for each attendant, the wages worked out in pence per acre are as shown below. In the last two columns are given the total cost of labour and fuel per acre. The prices taken for the purpose of the table were:—Paraffin, 1s. 11d. per British gal.; petrol, 3s. 5d. net. per gal.

	Wages.		*Labour and Fuel.*	
	Min.	Max.	Min.	Average for whole class.
	d.	d.	s. d.	s. d.
Class I.—Two-furrow, light ...	28·5	44	7 5	9 5
heavy	31·5	47	9 2	10 11
Class II.—Three-furrow, light...	19·6	35·8	5 7	8 4
heavy	23·4	72	7 7½	11 8
Class VII.—Motor ploughs, light	26·3	43·5	6 5	9 3½
heavy	23·4	58	6 3½	13 2

The figures for the total costs given in the table were taken on the actual acres ploughed, and represent the total per acre

for the items of attendants and fuel only, calculated on the net ploughing time and the total fuel used.

Average figures for five tractors in each class which performed the work in the shortest time and with the lowest fuel consumption are perhaps of more assistance than any other comparative figures for judging class against class; but comparison is vitiated by the warning that in any class the five speediest may not be the five most economical in fuel. Again, certain tractors were permitted to compete in both Classes I and II, and there is no indication as to whether or not the same tractor appears in the first five in both classes.

Class.	Land.	Average of Five Lowest.			
		Time in hours per acre.	Fuel in gal. per acre.	Wages in pence per acre.	Fuel cost in pence per acre.
I	Light	1·92	2·90	31·5	66 7
	Heavy	1·96	3·81	35·3	88·4
II	Light	1·21	2·96	21·8	68·0
	Heavy	1·52	3·63	27·4	83·5
VII	Light	1·89	2·84	33 9	65·3
	Heavy	2·08	3·78	37·4	86·9

The judges suggest that to compare the figures for fuel consumption it is convenient to adopt "equivalent acres," *i.e.*, "the number of acres that would have been ploughed if the drawbar pull had remained constant at 500 pounds per ploughshare, estimated from the actual drawbar pull observed and the actual area ploughed." The resultant figures cannot, however, be anything but arbitrary, and it seems better on the whole to adopt the actual recorded figures.

Accepting the figures at their face value it will be deduced that in the case of the more efficient tractors in each class there is very little to choose in the matter of fuel consumption, and that while the tractors pulling three-furrow ploughs had the advantage in time there is practically nothing between Class I (tractors pulling two furrows) and Class VII (motor ploughs). While these factors are of great importance, they are far from covering the whole range of questions which should determine the choice of a tractor, as for example:—Consumption of lubricating oil, dilution of lubricating oil by condensation of fuel, time taken to dismantle wheel grips, time taken to equip tractors for road-haulage, quite apart from a most important factor which short-period trials cannot be expected to discover, namely, cost of maintenance. Various

tests, such as uphill ploughing, road-hauling and belt work, were instituted, but only certain selected machines were subjected to each test and no comparative data are therefore available. No test was devised for demonstrating the advantage (if any) possessed by machines with three speeds over those with two speeds or one, a matter which certainly invites investigation and one which could easily be dealt with in a short-period trial. The important question of the relative advantage of wheels and caterpillar tracks is passed by with the remark that four " tractors were supported on chain tracks and in these no case was recorded of jamming by stones or other matter." Questions of adhesion, weight in relation to h.p., ranges of speed and many other points of importance are passed by in silence. The data being so scanty it follows that no useful purpose would be served in endeavouring to make a comparison between Classes I, II, and VII, and any of the other classes competing at the trials.*

It is indisputable that a report on short-period trials could be made much more informative than the present one. Clearly some of the points we have mentioned are not matters which can be dealt with adequately in the course of a few days or under the conditions which necessarily govern trials of this character; but still a very great deal can be done, and, as we have already indicated, a uniform annual report would supply comparative data of the utmost value, provided only that all modifications in design and particulars of the implements used were adequately recorded.

* Cf. *Journal*, Nov., 1920, p. 714

BEESWAX: METHODS OF EXTRACTION, AND THE PREVENTION OF WASTE.

W. HERROD-HEMPSALL.

WAX is not *gathered* by the worker bee, but is organically produced in her body from honey and pollen, by secretion. It is formed voluntarily by the bees filling their stomachs with honey, hanging in the hive in chain-like clusters, and remaining perfectly quiet for twenty-four hours. A good deal of pollen is consumed to make up for the wear and tear of tissue during wax secretion. During this period the wax glands convert the honey taken into their bodies into liquid wax, which exudes through tiny perforations into eight small pockets, or moulds, situated on the underside of the last four abdominal segments, where it hardens into small white scales (Fig. 1). It is then plucked out, made plastic by the admixture of saliva, and utilised for the building of the comb, the hermetic sealing of honey cells, and, with the addition of pollen, for the porous sealing of brood cells. It is computed that from ten to twenty pounds of honey are required to make one pound of wax. The work of wax secretion tells severely upon the vital powers of the bee, and being a valuable and costly product, none of it should be wasted.

When cleaning hives or appliances, a box should be kept for the collection of all refuse and burr combs. The scrapings from the floor board, which are generally thrown on the ground during spring cleaning, should be saved, although they contain a quantity of dirt and propolis, for there is generally sufficient wax to make it worth the trouble of collection and extraction. The honey combs used for extracting do not wear out, but last indefinitely; brood combs, on the contrary, become thickened by the cocoons and cast skins of the moulting larvæ, and must be continually renewed. Wax can therefore be obtained from old brood combs and the cappings from extracting combs.

Methods of Extraction.—The extraction of the wax may be made by using:—

(1) The Solar Wax Extractor.
(2) Steam.
(3) Boiling water.
(4) The heat of the oven.

The most efficient and economical method is the first. The cost of the extractor is the only expense incurred, as the sun

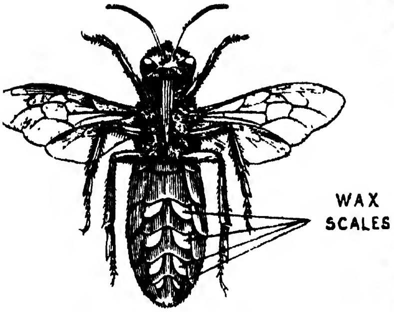

Fig. 1 -- Drawing of Worker Bee showing Wax Scales.

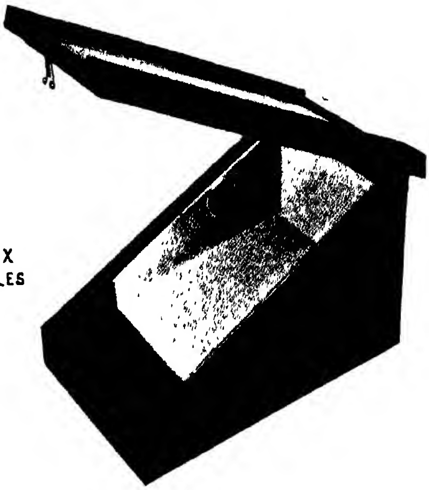
Fig. 2.— Solar Wax Extractor

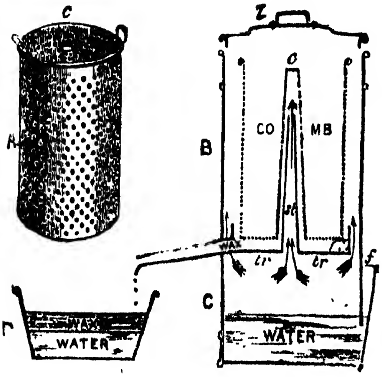

Fig. 3 — Gerster Wax Extractor.

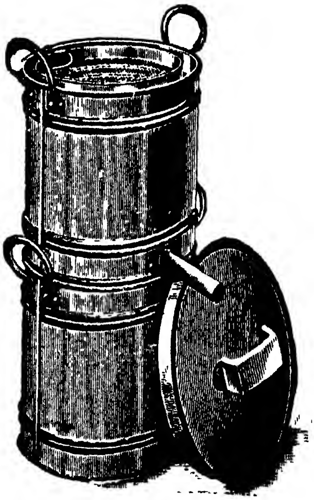
Fig. 4. Cottager Wax Extractor.

provides the necessary heat. The appliance is really a miniature garden frame, with a double glazed and hinged light (Fig. 2). Inside, the frame is fitted with a metal tray which slopes down to a tin trough covered with wire gauze. The extractor is placed in a sunny position and the material to be treated is spread thinly over the bottom of the metal tray. The wax melts and runs into the trough, being strained of impurities by the wire gauze covering. When the melted wax ceases to flow, the dross remaining in the tray is removed and a fresh supply of material given. Another advantage of this extractor is that no storage of old combs or refuse is necessary; these can be put in for treatment as collected.

If a garden frame is available, it can be used for extracting wax by placing the material to be treated in a perforated zinc tray over a metal box (such, for instance, as a biscuit tin), placed close up to the glass light. Wax extracted by solar heat improves in colour instead of deteriorating, as it may do when steam or boiling water is used.

The material to be extracted by methods (2) and (3) must be stored until required in an air-tight tin, for protection against the ravages of the wax moth. In the winter it can be melted over the kitchen fire by means of a Gerster wax extractor (Fig. 3). This is an arrangement similar to a domestic steamer, as illustrated in Fig. 3. It consists of a cylindrical, perforated, tin basket (A), having a cone-shaped tube running up the centre (c), which is also perforated, and open at the top to allow the steam to percolate right through the combs or wax that are placed in it for melting. The upper part of the appliance (B) consists of a circular shaped pan, having a false bottom or tray (tr.) about 1½ in. deep. This is fixed so that there is a space between it and the wall of the pan, in order that the steam can pass up the sides and into the perforated basket, as indicated by the arrows.

From this tray the melted wax passes through a tube (indicated in the drawing by the word "*wax*"). There is also a cone-shaped tube (st.) running up from the tray, which fits very loosely into a similar perforated tube (c) in the basket. When placed in position, as shown in section at B, this is open at the top to allow the steam to pass through as indicated by the arrows, and thus permeate the wax or combs in the basket. The basket does not fit close down on the tray, but is raised about 1 in. on three legs. The bottom pan is for water only.

The method of working is as follows:—The perforated basket is filled with comb which has first been broken into small pieces; these should not be pressed down, but put in as loosely as possible. The basket is placed in position in pan B, and covered with the lid (l). Pan B is now fitted on pan c, which has previously been filled with rain water. The appliance is then put on the fire, and when the water boils the steam will pass in the directions indicated and will melt the wax from the combs in the perforated basket. The molten wax will ooze out through the perforations, run down the sides of the basket into the tray, and thence out of the tube, where it drops into cold rain water, contained in a vessel (D) placed for the purpose of receiving it. As soon as it is cold, the wax will be found to have set in a cake, when it can be lifted off. When all the wax has been extracted the dross is removed from the basket and the process repeated.

As the water boils away very rapidly it will be necessary to replace it from time to time; by means of the funnel (f) this can be done without removing the appliance from the fire.

Cappings from the shallow combs, when cut off for extracting the honey, can also be melted in the same manner. Before putting them in the basket, however, they should be drained free from honey, well washed in rain water, and dried in the sun.

A cheaper form of wax extractor is shown in Fig. 4. This is made on similar lines to the Gerster, but the cost is reduced by omitting the central cone-shaped tube; in all other respects it is identical. As steam is not admitted into the centre of the perforated wire basket, the operation of extraction is prolonged.

To extract wax by means of boiling water, the material should be tied in a bag made of porous fabric, such as cheese straining cloth, and stood on laths of wood placed across the bottom of a copper or saucepan, so that the bag does not touch the bottom. The bag should be weighted with a stone, and water then poured in until it flows above the bag. The water should then be boiled very gently. The melted wax will percolate through the bag and float on the water, and when cold it can be lifted off in a solid cake. A little dross will be found on the bottom of the cake, but this can be removed by scraping. If a well-cleansed sample is desired, the cake should be remelted in a similar manner, and cooled slowly. Rain water must be used in methods 2 and 3, as hard water contains lime, which would spoil the texture and colour of the wax. More wax will be obtained if pressure is

applied to the bag while boiling, and in the case of old combs, if these are well soaked in water previously to melting.

If only a small quantity of wax is to be dealt with, it may be placed on a piece of perforated zinc over a bowl of rain water, and put in the oven. The wax will melt and drop through the perforated zinc into the water; the impurities will remain on the zinc and can be thrown away. The bowl is then taken out of the oven and the water and wax allowed to cool, when the latter will have set in a cake and can be lifted off.

The melting point of pure beeswax is between 63° and 64° C., which is higher than that of any other wax. The colour, which varies from pale primrose to orange red, depends to a great extent upon the variety of pollen consumed by the bees. It is a curious fact that dark honey produces a light wax, while light honey yields one of a darker hue.

For commercial purposes the lightest coloured wax commands the best price, and therefore, before extracting, it is advisable to grade the combs. Those which have not been occupied by brood, and also cappings removed from combs previous to extracting the honey, will yield the best wax, and should be sorted out and melted separately from old combs, which will yield a darker and consequently less valuable wax.

It is unfortunately a fact that adulteration of beeswax sometimes occurs. The materials used for this purpose include tallow, stearin, paraffin, vegetable wax, resin, and ozokerit. Owing to their low melting point, the addition of any of these to beeswax used for making comb foundation is disastrous in its effect. The following are simple tests for detecting adulteration :—

(1) A small piece of wax placed in the mouth and chewed should not adhere to the teeth, or become pasty, but, generally speaking, should disintegrate into small fragments, and have no unpleasant taste.

(2) Place a piece of suspected wax (of the size of a small nut) into a test tube, half fill with spirits of turpentine, and carefully warm over the flame of a spirit lamp. If the solution is cloudy, or a deposit is thrown down, the solution is not complete, and the wax is adulterated, as spirits of turpentine completely dissolves pure beeswax.

A large quantity of wax is imported into this country from Germany, Holland, Madagascar, Chili, Brazil, and various other countries. The value of the importations in 1919 of beeswax, ozokerit, and earth wax was £1,045,415, of which the greater portion was probably beeswax. It is important, therefore, that none of this valuable material should be wasted, for when recovered and sold it will reduce to a considerable extent the large

sum of money hitherto spent on its importation. Further, by saving wax and having it made into comb foundation for his own use, the bee-keeper will add considerably to the profits of the apiary; the cost of manufacture is trifling compared with the price that has to be paid for the finished article.

Beeswax is used commercially for the following purposes:—

Comb foundation for bee hives.
Grafting wax for fruit trees.
Furniture and floor polish.
Waterproofing packing paper.
Boot polish and dubbing.
Candles for churches.
Plaster casting.
Cosmetics.
Salves.
Stopping teeth and making mouth models.

NOTES ON FEEDING STUFFS FOR JULY.

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THE dry conditions existing over the greater part of the country have affected considerably the quantity and quality of pasture available for cattle at grass, and milch herds particularly will need a certain amount of cake if the milk yield is to remain satisfactory.

Barley and Barley By-products.—Barley, once a valued grain for bread-making, is now used almost exclusively for brewing and stock feeding. In regard to its protein constituents barley occupies a position intermediate to oats and maize, has less oil than either of these grains, and contains more starchy material than oats. It forms quite a good feed for most stock, although in Great Britain the greater part of the barley fed is used for pig fattening. For putting finish on fattening pigs, barley meal possesses a deservedly high reputation. In California rolled barley forms a common food for horses, and a mixture of oats and barley, sown in the proportion of one part of barley to two of oats is an excellent concentrate for milch cows. In feeding barley, particularly to fattening stock, the most suitable fodder to use with advantage is lucerne, sainfoin, or clover hay.

In brewing, the chief by-products obtained are malt sprouts (malt coombs) and brewers' grains. In obtaining the malt used by the brewer, the grains are allowed to germinate until the sprouts are well developed. The temperature is then raised to kill the grains, which are then dried off. The separated, dried, shrivelled sprouts are marketed as *malt coombs*, the dried grains themselves forming the malt. These malted grains are then steeped in the brewing vats, and after treatment, the residue left is called *wet brewers' grains*, and has a ready sale as feed for milch cows. In most cases, the wet brewers' grains are dried off and sold in the dried condition as *brewers' grains.*

Dried Brewers' Grains.—Dried brewers' grains form a somewhat bulky feed, and are not suitable for pig feeding. They may be fed safely to dairy cattle, and may replace up to half the usual oat ration for horses.

NAME.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	43/9	400	12 5	1 6	10 19	71	3/1	1·64
„ Canadian „ -	42/-	400	11 15	1 6	10 9	71	2/11	1·56
Oats, English „ -	46/-	336	15 7	1 9	13 18	59·5	4/8	2·50
„ Argentine „ -	30/6	320	10 13	1 9	9 4	59·5	3/1	1·64
Maize, Argentine* -	50/-	480	11 13	1 5	10 8	81	2/7	1·38
Beans, English spring -	—	—	—	—	—	—	—	—
„ „ winter -	56/-	532	11 16	3 1	8 15	66	2/8	1·43
„ Rangoon - -	8/3	112	8 5	3 1	5 4	66	1/7	0·85
Peas, English blue -	60/-	504	13 7	2 13	10 14	69	3/1	1·65
„ „ dun -	75/-	504	16 13	2 13	14 0	69	4/1	2·19
„ „ maple -	80/-	504	17 16	2 13	15 3	69	4/5	2·37
„ Japanese* - -	117/6	504	26 2	2 13	23 9	69	6/9	3·61
Buckwheat - - -	71/-	392	20 6	1 9	18 17	53	7/1	3·79
Rye, English - -	57/3	480	13 7	1 8	11 19	72	3/3	1·74
Millers' offals—Bran -	—	—	6 15	2 10	4 5	45	1/11	1·03
„ „ Coarse middlings	—	—	8 15	2 10	6 5	64	1/11	1·03
Barley meal - - -	—	—	14 5	1 6	12 19	71	3/8	1·96
Maize „ - - -	—	—	10 15	1 5	9 10	81	2/4	1·25
Fish „ - - -	—	—	20 10	7 12	12 18	53	4/10	2·59
Linseed - - -	—	—	19 5	2 16	16 9	119	2/9	1·47
„ Cake, English -	—	—	14 12	3 12	11 0	74	3/-	1·64
Cotton seed „ „ -	—	—	11 15	3 5	8 10	42	4/-	2·14
„ „ decorticated	—	—	14 0	5 6	8 14	71	2/5	1·29
„ Meal, decorticated	—	—	11 17	5 6	6 11	71	1/10	0·98
Coconut cake - -	—	—	10 2	3 0	7 2	79	1/10	0·98
Groundnut cake - -	—	—	9 2	3 9	5 13	57	2/-	1·07
„ „ decorticated	—	—	12 17	5 5	7 12	73	2/1	1·12
Palm kernel cake* -	—	—	7 5	2 1	5 4	75	1/5	0·76
Brewers' grains, dried, ale	—	—	7 0	2 7	4 13	49	1/11	1·03
„ „ wet „ -	—	—	0 19	0 12	0 7	15	0/6	0·27
Distillers' „ dry -	—	—	9 10	2 16	6 14	57	2/4	1·25
„ „ wet -	—	—	—	—	—	—	—	—
Malt culms - - -	—	—	7 0	3 6	3 14	43	1/9	0·94

* Price at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

Wet Brewers' Grains.—Owing to their watery nature and cost of transport, skill is needed in feeding wet brewers' grains to dairy cattle, and care must always be taken to feed the grains

in a wholesome condition and in *clean* troughs. In some parts of Kent, wet brewers' grains are stored in practically air-tight pits, a certain amount of salt being added when filling the pits. Under these conditions wet grains will keep perfectly sound and wholesome for months. Unless some such method of keeping wet grains is available, their use for feeding dairy cattle is impossible unless the farm is within easy road distance of a brewery.

Malt Sprouts or Malt Coombs.—Malt coombs form a fairly bulky food, a good sample being light yellow in appearance, and having a very pleasing odour. Fed judiciously this feeding stuff is appreciated by cattle, sheep and horses. Dairy cattle may be fed up to two or three pounds per head daily. In feeding large quantities it is advisable to soak for several hours before feeding, since malt coombs swell considerably in water.

Barley Feed.—This by-product is obtained in the manufacture of pearl barley, has about the same feeding value as wheat bran, and is not usually available in the English market, such quantity as becomes available usually finding its way into compound meals and cakes.

The following figures compiled from various sources give an idea of the composition of barley and its by-products:—

	Water.	*Protein.*	*Oil.*	*Fibre.*	*Starchy material.*	*Ash.*
Feeding Barley ...	14·9	8·6	1·5	4·5	67·9	2·6
Brewers' grains (wet)	67·6	7·5	2·8	6·1	14·6	1·4
" " (dry)	10·3	18·3	6·4	15·2	45·9	3·9
Malt Coombs ...	10·0	24·4	2·0	14·0	42·4	7·2
Barley Feed	10·2	12·7	3·4	7·8	61·7	4·2

SUMMARY OF THE SEEDS REGULATIONS, 1921.

THE main provisions of the Draft Regulations under the Seeds Act, 1920, are as follows *:—

REGULATION 2 specifies the kinds of seed to which the Act applies and includes all the principal kinds of grasses, clovers, cereals, field seed, garden seed, flax seed, linseed and forest tree seed. Seed potatoes are also included under the Act.

REGULATION 3 sets out the particulars to be stated in the case of a sale or exposure for sale of seeds or seed potatoes and may be summarised as follows:—

Seed Potatoes.

(1) Name and address of seller.
(2) Class, *i.e.*, Class 1 (Scotch); Class 1 (Irish); Class 1 (English once grown); Class 2.
(3) Variety.
(4) Size and dressing.

The terms "Class," "Variety," "Size and Dressing" are defined and special concessions are made in the case of seed potatoes sold "as grown."

Grass and Clover Seed.

(1) Name and address of seller.
(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.
(3) Kind of seed.
(4) Country of origin.
(5) Percentage of purity.
(6) Percentage of injurious weeds where it exceeds 1 per cent. in the case of clovers or 2 per cent. in the case of grasses.
(7) Percentage of germination.
(8) Percentage of pure germinating seed ("Real value").
(9) The bushel weight in the case of rye-grasses.
(10) The presence of Dodder if present to the extent of more than one seed in 1 oz. of Wild White Clover or in 2 oz. of Alsike or White Clover or Timothy, or in 4 oz. of Red or Crimson Clover or Lucerne.
(11) The presence of Suckling and other specified clovers when present to the extent of more than 2 per cent. in White, or Wild White or Alsyke Clover.
(12) The presence of Burnet if present to the extent of more than 5 per cent. in Sainfoin.
(13) The percentage of hard seeds in Clovers, Trefoil, Lucerne and Sainfoin.

* Copies of the draft regulations may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1. Copies of the Seeds Act, 1920, may be obtained either directly, or through any Bookseller, from H.M. Stationery Office, Imperial House, Kingsway, W.C.1. (Price 2d. net).

(14) Minimum percentages of purity and germination are specified for the rye-grasses and such seeds testing at or above these figures may be so described without stating the actual percentages.

(15) With certain exceptions, all the above particulars must be given in respect of each kind of grass and clover seed included in a mixture and also the proportion by weight of each kind of seed.

Cereal Seeds.

(1) Name and address of seller.

(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.

(3) Kind of seed and distinctive name of variety.

(4) Percentage of germination, provided that if such is at or above the minimum percentage specified in the Regulations a statement to that effect, including the authorised minimum percentage, is sufficient.

Field Seeds.

(1) Name and address of seller.

(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.

(3) Kind of seed.

(4) Percentage of purity if below 97 per cent.

(5) Percentage of germination, provided that if such is at or above the minimum percentage specified in the Regulations a statement to that effect, including the authorised minimum percentage, is sufficient.

Garden Seeds. (The same as in the case of *Field Seeds,* with the exception that the purity of carrot seed need not be stated unless it is below 90 per cent.

Packeted Seeds.—The particulars required in the case of a sale of garden seeds do not apply to packets of peas or beans (not exceeding 2 lb.) or of other garden seeds (not exceeding 8 oz.) if the following particulars are stated on the packet :—

(1) Name and address of seller.

(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.

(3) Kind of seed.

(4) Percentage of purity if below 97 per cent. (or 90 per cent. in the case of carrot seed).

(5) Percentage of germination, provided that if such is at or above the minimum percentage specified in the Regulations a statement to that effect is sufficient.

(6) The Season in which the seeds have been packeted.

Flax Seed and Linseed.

(1) Name and address of seller.

(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.

(3) Kind of seed.

(4) Country of origin.

(5) Percentage of purity.

(6) That Dodder is present if present to the extent of more than one seed in 4 oz.

(7) The percentage of germination.

Forest Tree Seed.

(1) Name and address of seller.
(2) That the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.
(3) Kind of seed.
(4) Percentage of purity.
(5) Percentage of germination (except in the case of broadleaved species).
(6) Date of collection of seeds.
(7) Country of origin.

REGULATION 4 prescribes the injurious weed seeds to which reference is made in Section 3 of the Act and Regulation 3 (1) (e) and (j). Under Section 3 of the Act it is illegal to sell or sow seeds containing more than a prescribed percentage of these injurious weeds (the percentage has been fixed at 5 per cent. by weight), and under Regulation 3 (e) and (j) they must be declared to be present when present to a greater extent than 1 per cent. in the case of grass and 2 per cent. in the case of clover seed.

REGULATION 5 prescribes the method in which samples must be taken for testing, the quantity of seed to be used for testing, &c.

REGULATION 6 describes the circumstances in which a licence may be issued, exempting a sale of seeds from the requirements of Section 1 of the Act.

REGULATION 7 defines such terms as "percentage of purity," "percentage of germination," &c.

THE FIRST, SECOND, THIRD AND FOURTH SCHEDULES set out the "authorised minimum percentages of germination." In the case of sales of certain kinds of seed, when the percentage of germination is at or above the authorised minima, this fact may be declared instead of the actual percentage of germination.

THE FIFTH SCHEDULE prescribes the limits of variation which will be allowed in connection with discrepancies in the percentages of germination, purity, and of injurious weed seeds. For instance, where the percentage of germination is stated by the seller to be 90 per cent., it shall not be deemed to be incorrect if the seed is shown to germinate 6 per cent. more or 6 per cent. less than that figure.

THE REQUIREMENTS OF THE SEEDS ACT, 1920, COMPARED WITH THOSE OF THE TESTING OF SEEDS ORDER, 1918.

The provisions of the Seeds Act, 1920, and of the Draft Seeds Regulations, 1921, are mainly the same as those required under the Testing of Seeds Order, 1918, which has been in operation since January, 1918. There are, however, certain alterations which have been made in the light of the Ministry's experience in administering the Order. The principal alterations may be summarised as follows:—

Seeds Act, 1920.

1. *Power to issue Regulations.*—The Minister is empowered to issue Regulations for carrying the Act into effect provided that such Regulations are drafted in consultation with the interests concerned (Section 7 (1)).

2. *Tests, where and when to be made.*—Tests for the purpose of a declaration under the Act, in the case of seeds other than garden seeds, must be made either at an Official Seed Testing Station or at a private station licensed by the Ministry (S. 2. (1)). (Under the Order such tests may be made by anyone and at any place.) These tests must also be made within a period of twelve months before the date of sale instead of, as under the Order, the date of the test having to be declared if more than six months old.

3. *Injurious Weed Seeds.*—Section 3 prohibits not only the sale but also the sowing of seeds containing more than a prescribed percentage of injurious weed seeds.

4. *Administration of the Act*:—

(*a*) *Seedsman's right to know result of tests.*—A copy of the certificate of the results of tests carried out at the Official Seed Testing Station on samples drawn officially for control purposes must be sent to the owner of the seeds (S.4 (3)).

(*b*) *Ministry's power to require name of seedsman's supplier.*—If the results of a test of a control sample are unsatisfactory the Ministry may require the owner of seeds from which the control sample has been taken to furnish the name of the person from whom the seeds were previously obtained (*i.e.*, the wholesaler). In such a case the person in question must be supplied with a portion of the sample and a copy of the result of the Official test (S. 4 (5)).

5. *Civil Proceedings.*—If the purchaser of any seeds wishes to have a test made for the purposes of civil proceedings a sample must be taken within 10 days of delivery and divided into two parts, one part to be sent to the Official Seed Testing Station for testing and the other part to the seller.

6. *Transactions exempted from the Act.*—The Act does not apply to certain transactions particulars of which are given in this *Journal* for October, 1920, p. 606. Under the Order the exemptions included only a sale of seeds "as grown" and a sale for delivery outside the United Kingdom.

7. *Application to Ireland and Scotland.*—The Act applies to Ireland and Scotland as well as to England and Wales, with the exceptions that the internal seed trade of Ireland will continue to be regulated under the Weeds and Agricultural Seeds (Ireland) Act, 1909, and that the Regulations for Scotland are to be issued by the Scottish Board.

Seeds Regulations, 1921.

1. *Seeds controlled by the Act and not by the Order.*—The following seeds are scheduled under the Act but are not included under the Order :—

Seed Potatoes.	Sugar Beet.
Field Peas.	Flax seed and Linseed.
„ Beans.	Forest tree seeds.

2. *Tests.*—In all cases (except in relation to Seed Potatoes) a statement must be made that the seeds have been tested in accordance with the provisions of the Seeds Act, 1920.

3. *Seed Potatoes.*—The particulars to be given are similar to those required under the "Seed Potatoes Order, 1918," viz., a statement as to the class, variety, size and dressing (see Summary of Seeds Regulations, 1921, above).

4. *Grass and Clover Seed.*—The particulars to be given are similar to those required under the Order with the following additions :—

(a) the "real value" or percentage of pure germinating seed must be stated.

(b) the bushel weight of ryegrass is required.

5. *Flax Seed, Linseed, and Forest Tree Seeds.*—The particulars to be given in these cases are set out in the summary of the Draft Seeds Regulations, 1921, above.

6. *Packeted Seed.*—Sellers of these may either give the particulars required in the case of a sale of Garden Seeds (see Reg. 3 (1) (a), (b), (c) and (D)), or, print on the packet the particulars set out in the summary of the Seeds Regulations, 1921, above, which include a statement as to the season in which the seed was packeted. Under the Order, nothing had to be declared by sellers of packets if the germination and purity of the seeds were above "Standard."

7. *Samples.*—Tests for the purpose of a Declaration may now only be made on samples drawn in accordance with the methods which under the Order only applied to the drawing of "control" samples.

8. *Method of Testing.*—The method of testing under the Testing of Seeds Order has been what is known as the "Irish method." Under the Act this will be altered to the "Continental" or "Universal" method.

9. *Minimum Percentages of Germination.*—These are prescribed in Schedules 1, 2, 3 and 4 for various kinds of seeds. When the germination of the seed specified is at or above these percentages that fact may be stated instead of declaring the actual figures obtained as a result of a test. In the case of most of the garden and field seeds the minimum percentage is 5 per cent. higher than the "Standard" prescribed under the Order. The germination of mangold and beet is to be given as the percentage of germinating clusters and, not of the sprouts as hitherto. Minimum percentages are now prescribed for the ryegrasses.

Except in the case of small packets of seeds, where a statement is made that the seed is not less than the authorised minimum percentage of germination prescribed the minimum percentage in question must be given.

FEES CHARGED FOR TESTING AT THE OFFICIAL SEED TESTING STATION.

The following are the revised fees to be paid for samples tested at the Official Seed Testing Station :—

For samples of seed which the farmer himself is proposing to sow, 6d. per sample.

In the case of tests which a farmer requires for the purpose of a declaration for sale :—

	per sample.
Cereals	2/-
Roots and Vegetables, other than Mangold and Beet	3/-
Mangold, Beet, Grasses or Clovers	4/-

The address to which samples for testing should now be addressed is :— *The Chief Officer, Official Seed Testing Station,* 18, *Leigham Court Road, Streatham Hill, London, S.W.*16, but early in August it is hoped to transfer the Station to its permanent premises, Huntingdon Road, Cambridge. Notice will be given in the press when the transfer takes place.

Agricultural Machinery After the War.

THE Report on Agricultural Implements and Machinery (Cd. 1315) which has been prepared by a Committee acting under the Profiteering Acts, 1919 and 1920, is of very considerable interest to agriculturists. Farmers may be relieved to hear that despite the high prices which they have been asked to pay in recent years there is no evidence of profiteering, and certain of the figures quoted by the Committee will bring conviction to the most sceptical. The figures relating to churns can be put into an easily intelligible table:—

Year.	*Average List Price.*	*Average Selling Price.*	*Average Total Costs.*	*Average Profits.*	Per cent. of costs.
	£ s. d.	£ s. d.	£ s. d.	s. d.	
1914 ...	4 11 4	3 2 0	2 8 6	13 6	21.77
1919 ...	8 17 6	7 2 3	5 17 2	25 1	17.63
1920 ...	9 2 4	7 4 8	7 4 3	0 5	0.27

The Committee find that dealers are not acting other than fairly in their position of connecting link between manufacturer and farmer: their commissions do not seem unduly high.

A great deal of the report confirms the conclusions of the Departmental Committee on Agricultural Machinery,* particularly in regard to manufacture and export trade, although some of the statements of the more recent Committee are not made with the qualifications which the former Committee considered necessary. "The conservatism of the farmer," they say, "is proverbial, and manufacturers have had to contend with much inertia and prejudice in bringing their appliances to the notice of the farming public. Generations of farmers have looked with some degree of suspicion, often with undisguised hostility, upon any innovation, and this has been especially the case with the substitution of mechanically propelled implements in the place of horse-drawn machines. It has only been after much hesitation that the average farmer has allowed himself to be persuaded of the efficacy of new patterns and the labour-saving which their adoption would entail." This reads rather like the manufacturers' case: there is another side to the story, part of which the Report discloses.

The Committee found that in spite of a general consensus of opinion as to the desirability of standardisation, nothing definite had been done by manufacturers, and they refer to the notorious case of British plough types. "Such advantages as are derived from the present policy of manufacturing large varieties of types appear to be counterbalanced by the enormous economies to be

* Cmd. 506. *Cf. Journal*, April, 1920.

obtained by standardisation." Again, many firms have no effective costings system.

English firms are comparatively small and this is another element in cost. One circumstance which has an intimate relation to the size of English firms is the progressive decline of the export trade, although there have been gains in some directions, and until the War the export of engines and thrashing machines was considerable, particularly to Russia and Central Europe. Russia in fact absorbed nearly 40 per cent. of the total British exports of agricultural machinery. Although the Report does not say so in as many words, it is obvious that in a country of the size of the British Isles there cannot be really large production for the home market: a large foreign trade is essential before the economies of large scale production can be introduced. The most striking of the conclusions of the Committee is that "the industry will only resume its former healthy condition when the markets of Central and Eastern Europe are effectively reopened." That, it may be added, will not be of benefit only to the British manufacturer but to the British farmer as well, for a small production means higher relative costs and higher prices.

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Proposed International Potato Conference.

IT is proposed to hold an International Potato Conference at the Royal Horticultural Society's Hall, Westminster, London, on 15th, 16th and 17th November. A Joint Committee of the Ministry of Agriculture and the Royal Horticultural Society is making the necessary arrangements, and the programme will include the reading of a number of papers by experts, who will deal with various aspects of potato culture. Among the papers are the following:—

"Degeneration of Potatoes," by Dr. R. N. Salaman (England).

"Potato Breeding, Selection and Development Work," by W. Stuart (U.S.A.).

"Industrial and Commercial Uses of Potatoes," by H. V. Taylor (Ministry of Agriculture).

"Leaf Curl," by H. M. Quanjer (Holland).

"Life History of the Wart Disease Organism and its Relation to Immunity from Wart Disease," by Prof. Blackman (London).

"Recent research in Potato Blight," by Dr. Petherbridge.

"Leaf Curl" and "Mosaic in Potatoes," by A. D. Cotton (Ministry of Agriculture), and W. A. Orton (U.S.A.).

There will also be an exhibition of British varieties of potatoes, with specimens of diseases in this country, and descriptions of British methods of dealing with them. The

presidential address will be delivered by Sir Daniel Hall, K.C.B., F.R.S., Chief Scientific Adviser to the Ministry of Agriculture, and a full report of the conference will be published later in book form. The Committee understands that the National Potato Society will hold their annual show at the Royal Horticultural Society's Hall in conjunction with the conference. Mr. H. V. Taylor, of the Ministry of Agriculture, and Mr. R. Dykes, of the Royal Horticultural Society, are the honorary secretaries of the conference. All interested in potato growing are invited to attend and take part in the discussions, so adding to the common stock of knowledge on the subject.

World's Poultry Congress and Exhibition.

THE first World's Poultry Congress, convened by the International Association of Poultry Instructors and Investigators, will be held at The Hague, Holland, on 6th-13th September this year. Delegates from many Governments, teaching and experimental institutions, poultry and other societies, as well as private individuals interested in poultry, will be assembled for conference and for exchange of ideas and experiences.

The Netherlands Government is co-operating in every possible way with the promoters of the Congress, which is under the patronage of Their Majesties The Queen and Queen Mother of Holland, while H.R.H. Prince Henry of the Netherlands is president of the honorary committee, the members of which consist chiefly of Ministers of the Netherlands Government. The executive committee which will make the necessary arrangements has been appointed by the Netherlands Minister of Agriculture, Commerce and Industry, and will have as its first president Dr. H. J. Lovink, of The Hague, and as its second president Mr. Ed. Brown, F.L.S., president of the British National Poultry Parliament.

The Congress will be divided into four sections, each of which will have its own bureau to regulate its work. The chairman of each section will be able to speak at least four languages, while all reports and other publications issued will be printed in at least three languages. A wide range of papers, written by many leading authorities in the poultry world, will be submitted for the consideration of the Congress. The Ministry of Agriculture will be represented officially, and has prepared a paper on "Poultry Education in England and

Wales." Membership of the Congress is open upon payment of a fee of £1, and all who are interested in the development of the poultry industry are cordially invited to attend. Arrangements have been made for the accommodation of visitors at fixed and reasonable rates. The programme includes excursions to neighbouring places of interest.

World's Poultry Exhibition.—Simultaneously with the Congress the World's Poultry Exhibition will be held. This will not be a competitive show, but an exhibition of the best breeds of poultry from various countries, as well as poultry houses and appliances, books and other literature, diagrams and photographs. There will be also scientific demonstrations illustrating the work of instructors and investigators. The countries represented at the Congress will have their own committees and sub-committees to arrange for the preparation and reading of papers and the preparation of exhibits. The honorary secretaries of the British Committee are :—

Prof. R. C. Punnett, M.A., F.R.S., Whittinghame Lodge, Cambridge.
Mr. T. R. Robinson, F.S.I., 3, Vincent Square, Westminster, London, S.W.1.

to whom all enquiries relating to the Congress and Exhibition should be addressed. Many countries are arranging to send exhibits of representative poultry and poultry appliances. No prizes will be awarded, but each exhibitor will receive a medal and diploma.

London Fruit Exhibition.

UNDER the auspices of the Ministry, an exhibition—the first of its kind—of home-grown and imported fruit will be held in London in the autumn, when varieties of fruit grown in the United Kingdom will be placed in competition with varieties grown in the Colonies and in certain foreign countries. Such an exhibition will, it is anticipated, be extremely helpful to our own fruit growers as well as to those engaged in placing foreign and Colonial fruit on our markets. Although much of our home-grown fruit is good, the methods of presenting it on the market leave much to be desired, and our growers would be well advised to give close attention to this side of the exhibition.

The three largest shows for English fruit are those held annually at Wisbech, Maidstone and Worcester. This year these three shows will be incorporated in the London Fruit

Exhibition, which will also, it is hoped, include exhibits from Scotland, Wales and Ireland. Thus the autumn exhibition in London will be a national one, and the exhibits will be the best and most representative of the United Kingdom and properly comparable with those from Canada, California and other places.

The Ministry has appointed an advisory committee, which is already at work, to organise the exhibition, and it is hoped to announce in the Press at an early date the full programme, which will be of a novel and interesting character. The exhibition will also be of interest to the general public, whose knowledge, for instance, of the best varieties of apples for eating or cooking is too often limited to a chance purchase of a choice specimen. One of the results of the London Fruit Exhibition will undoubtedly be to popularise the best varieties of fruit and so stimulate growers in the United Kingdom to supply the increased demand for them.

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Courses in Fruit and Vegetable Preservation.

THE courses successfully inaugurated last season in fruit and vegetable preservation at the Ministry's Experimental Station, Campden, Gloucestershire, are to be continued until October during the current year, with the exception of the month of July. A course lasts a fortnight and covers fully every phase of the subject. The fee is 30s. Full particulars can be obtained from the secretary of the Station at Campden. As the accommodation for students is limited, early application is desirable.

International Institute of Agriculture.

THE Permanent Committee of the International Institute of Agriculture at Rome has forwarded the text of a resolution passed at its last meeting, under which the distinction of "Membre donateur de l'Institut International d'Agriculture" may be conferred upon anyone who, being desirous of testifying in a practical way to the ideals of the Institute, presents either in money or in kind a gift of the value of not less than ten thousand lire. The names of donors will be inscribed on a marble tablet, which will be affixed in the building of the Institute at Rome. The first "Membre donateur" to be nominated is M. Victor Vermorel, Member of the National Agricultural Academy of France, a former Senator, who has recently given a generous donation.

In this *Journal* for April last (p. 5), brief particulars were given of the origin and constitution of the Institute. It was founded in 1905 to study the conditions of the world's agriculture, to collect and disseminate information on economic and technical agricultural questions, and generally to aid agriculture throughout the world. The best known feature of the Institute's work, however, is the preparation of monthly reports of the estimated world production of crops and available supplies. These are published very widely and appear in the newspapers of practically every civilised country. In addition to these statistics, the Institute issues a bulletin summarising the information given in technical publications throughout the world in regard to agricultural investigations, plant diseases, &c., and also a bulletin dealing with the economic side of agriculture.*

Arable Dairy Farms: Restricted Programme.

ARABLE dairy farms, established by the Ministry for experimental purposes, have suffered from conditions that are part of the aftermath of war. It will be remembered that this form of dairying was made the subject of prolonged and satisfactory experiment at the Harper Adams College, Newport, Shropshire, and that the theory these experiments may be said to have supported is, in brief, that continuous cropping and soiling enable a farmer to keep a cow in the best possible condition on the produce of two acres or less. On the ideal arable dairy farm the land is under crops—chiefly forage crops—all the time. The cows do not graze, but are turned out every day for brief exercise.

When it was proposed to test the economic possibilities of arable dairy farming, arrangements were made for the establishment of ten demonstration holdings, and a commencement was made at nine centres, seven in England and two in Wales. Unfortunately, the cost of building increased enormously soon after the inception of the scheme; the construction of necessary accommodation was delayed, and ultimately, building prices increased to a point that removed the economic basis from certain of the undertakings. This will be readily understood when it is remembered that an arable dairy holding should carry at least twice the head of stock of a pasture holding and that the homestead must be proportionately larger. Following

* The chief publications of the Institute may be obtained from the Ministry. Particulars of subscription rates will be sent on application.

the conditions that prevailed in the building trade came the pressure for economy in public expenditure, so that of the nine holdings referred to above the Ministry felt compelled to relinquish six on which the buildings had made little progress, but retained three, Grampound Road (Cornwall), Hucknall (Notts.) and Denham (Bucks.). The abandonment of six of these farms is to be regretted for many reasons, but it is satisfactory to know that there are three holdings on which the work is so well advanced as to justify completion; these will be fully equipped and will serve as experimental holdings. Every effort will be made to place the results of the working before the farming community, and it is to be hoped that, if the experiments prove successful and the practical value of arable dairy farms is demonstrated, there will be, as conditions improve, such an extension of private enterprise as will provide on a strict economic basis for the needs of the community. Interest among farmers has been stimulated already by visits to Harper Adams College, where much of the pioneer work has been carried out, and the results justify a considerable measure of optimism.

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Fream Memorial Prize.

THE Fream Memorial Prize which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. William Riddet, of Cubeside, Dalry, Ayrshire, a student of the West of Scotland Agricultural College, Glasgow. The value of the prize this year is about £6 10s., which is to be devoted to the purchase of books.

Rabies.—Since the last issue of the *Journal*, there have been no developments in the Middlesex and Berkshire districts. Two further cases, however, were confirmed on 10th June at Salisbury and at Chandler's Ford near Southampton, in the Wilts, Dorset, and Hampshire Area.

Foot-and-Mouth Disease.—*Ireland.*—On the 21st May the Ministry received information from the Irish Department of Agriculture that Foot-and-Mouth Disease had been confirmed at New Ross, County Wexford, and that an area of 15 miles radius therefrom had been scheduled for restrictions. The Ministry thereupon prohibited further landing of store stock from Ireland, but continued the existing provision for the landing of fat stock for slaughter within the landing places within 72 hours of landing.

The disease was confirmed among cattle which were practically grazing together, but owned by two people. Subsequently, on the 28th May, a further outbreak of disease was confirmed by the Irish Department in the same locality, and on the 2nd June disease was found to exist on a neighbouring farm. These later outbreaks did not, however, involve any extension of the Scheduled District.

On the 13th June, store cattle from parts of Ireland outside the 15 mile area, were admitted at certain landing places for 14 day quarantine in the landing place.

Great Britain.—The restrictions in connection with the outbreaks at Draycott (Derbyshire), Bebington (Cheshire) and North Runeton (Norfolk), referred to in previous issues of the *Journal*, have been withdrawn.

Yorkshire, Cheshire and Derbyshire.—The restrictions in connection with the outbreak of disease at Thurstonland, near Huddersfield, have now been withdrawn.

On the 18th May disease was confirmed at Harthill, Rotherham, on the Southern border of the West Riding of Yorkshire, and as a result the usual restrictions were imposed in respect of an area within a radius of 15 miles from that place. On the 22nd May the confirmation of disease on premises near Disley, Cheshire, necessitated the imposition of similar restrictions around Disley. Subsequently, disease was confirmed on ten other premises in Derbyshire, the latest of which was at Chapel-en-le-Frith on 7th June.

In view of the circumstances attaching to this extension of disease, restrictions were imposed as a precautionary measure over a much wider district so as to include the districts originally scheduled on account of the outbreaks at Harthill and Disley, and to comprise the whole of Derbyshire and Nottinghamshire, and portions of Cheshire, the West Riding of Yorkshire, Leicestershire and Staffordshire.

Within this district, two prohibited areas were described, one of about 5 miles radius surrounding Harthill, and the other including the farms in Cheshire and Derbyshire on which the remainder of the cases occurred, and to which the movement of animals by a dealer involved in one of the outbreaks had been definitely traced. In these two prohibited areas all movement of stock was suspended, with the exception of cases of special urgency, provision for which was made by the Inspectors of the Ministry. In the remainder of the extended scheduled district, movement into the district for immediate slaughter was permitted, as also the movement of animals within the district in cases of necessity, all such movements being by licence of an Inspector of

the Local Authority. The extent of this scheduled district was, however, considerably reduced as from 13th June by an order of the Ministry, one of the effects of which was to release from restrictions Derby, where the Royal Agricultural show was to be held at the end of June.

The origin of all these 12 outbreaks, most of which were discovered by the prompt action of the Ministry's Inspectors, has been due to the transactions of a dealer on whose premises one of the outbreaks occurred, and where the disease appeared to be of old standing. This dealer kept no proper record of his transactions, but animals were exposed by him at Chapel-en-le-Frith Market, Derbyshire, on the 5th and 10th May, at Macclesfield on the 6th May, and at Hayfield on the 12th May. No fewer than four of the eleven outbreaks occurred in animals exposed at Chapel Market on the 19th May. The original outbreak at Harthill occurred in animals which had passed through Marple Market, Cheshire, on the 2nd May.

Yorkshire (Otley District).—An outbreak of Foot-and-Mouth disease was confirmed on the 2nd June at premises near Otley. This outbreak owes its origin to contact with affected animals at one of the markets concerned in the Derbyshire outbreaks. The usual restrictions were imposed, and remain in force without modification.

Injurious Weeds Regulations, 1921.—With reference to the last paragraph of the notes on the suppression of weeds given at p. 275 of this *Journal* for June, regulations have now been made under Section 4 (10) of the Agriculture Act, 1920, declaring the following weeds to be the injurious weeds to which the sub-section shall apply :—

(1) Thistles *Carduus lanceolatus L.*—Spear Thistle.
Carduus arvensis Curt.—Creeping Thistle or Field Thistle.

(2) Docks *Rumex crispus L.*—Curled Dock.
Rumex obtusifolius L.—Broad-Leaved Dock.

(3) Ragwort *Senecio Jacobæa L.*

The position now is, therefore, that the Ministry of Agriculture may serve on the occupier of any land on which the above injurious weeds are growing, a notice requiring the destruction of such weeds.

Exportation of Horses and Conveyance of Horses by Railway.—The Diseases of Animals Act, 1910, as amended by the Exportation of Horses Act, 1914, prohibits the shipment of any horse, ass or mule, from any port in Great Britain to the Continent of Europe unless the animal has been examined immediately before shipment by a Veterinary Inspector appointed by the Ministry and certified by him to be capable of being conveyed and disembarked without cruelty, and also to be capable of being worked without suffering on arrival at its destination on the Continent. Provision has been made by the Ministry for the veterinary inspection of horses shipped under the above-mentioned Acts at the ports of London, Harwich, Hull, Goole, Folkestone, Southampton, Leith, Grimsby and Newhaven.

As it is of great importance that any illegal traffic in worn-out horses should on humanitarian grounds be prevented, the Ministry has asked Local Authorities of seaboard districts to co-operate with the Officers of Customs and Excise at the ports, with a view to prevent shipments of such horses contrary to the Acts, and the Board of Customs and Excise have agreed to assist by instructing their officers to notify to the Ministry and also to Local

Authorities any case in which it appears to them that the Acts are being contravened. This will enable action to be taken by the Local Authorities either to prevent illegal shipments taking place or to take legal proceedings against those found guilty of an infringement of the Acts.

The Ministry has further called the attention of all Local Authorities to the provisions of Articles 3, 4, 8 and 9 of the Horses (Importation and Transit) Order of 1913, which prohibit the carriage by water or by railway of any horse, ass or mule which, owing to infirmity, illness, injury, fatigue or any other cause, cannot be carried without unnecessary suffering during the intended transit.

Copies of a poster warning horse dealers and exporters of the requirements of the law in this matter can be obtained on application to the Ministry 10, Whitehall Place, London, S.W. 1.

Leaflets issued by the Ministry.—Since the date of the list given on page 283 of the June issue of this *Journal*, two new leaflets have been issued and circulated:—

No. 367.—Wither Tip and Brown Rot in Plums.
„ 369.—Backyard Poultry Keeping.

The following leaflets have been revised and brought up to date:—

No. 8.—Assessments of Local Rates.
„ 19.—Pea and Bean Weevils.
„ 68.—Currant and Gooseberry Aphides.
„ 69.—The Lackey Moth.
„ 86.—Brown Rot of Apples.
„ 131.—Apple and Pear Scab.
„ 137.—Potato Scab.
„ 188.—Fumigation with Hydrocyanic Acid Gas.
„ 189.—Insurance of Farming Stock against Fire.
„ 193.—Dry Rot in Potatoes.
„ 234.—The Die-back Disease of Gooseberry.
„ 258.—Rural Party Line Telephones.
„ 265.—Rabbit Keeping.
„ 279.—Technical Advice for Farmers.
„ 282.—Scheme for the Improvement of Livestock.
„ 333.—Fish Meal as a Food for Livestock.

The following leaflets have been withdrawn from circulation:—

No. 47.—The Asparagus Beetle.
„ 90.—The Pith Moth.
„ 163.—White Rust of Cabbages.
„ 314.—The Manurial Value of Shoddy.

The following leaflets have been re-written:—

No. 49.—Bark Beetles and Shot Borers.
„ 115.—Coral Spot.
„ 278.—Linseed as a Farm Crop.
„ 304.—Husk or Hoose in Calves.
„ 354.—Jam-making.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 5.

AUGUST, 1921.

NOTES FOR THE MONTH.

Corn Production Acts (Repeal) Bill.

At the time of going to press, this Bill has passed the Third Reading Stage in the House of Commons. Further amendments may be introduced in the House of Lords. The Bill as it stands at present provides (a) for the repeal as from 1st October, 1921, of the Corn Production Acts. 1917 and 1920, (b) for the payment in respect of wheat and oats produced in 1921 of grants of £3 per acre in the case of wheat and £4 per acre in the case of oats, and (c) for the payment of a sum of £1,000,000 to be devoted to the promotion of agricultural education and research, of which £850,000 is to be applied in England and Wales and the balance in Scotland.

The repeal of the Corn Production Acts involves the abolition of the Agricultural Wages Board and of the District Wages Committees together with the existing machinery for fixing a minimum wage for agricultural labour. In place of the existing arrangements, it is proposed to establish voluntary Joint Conciliation Committees composed of representatives of both employers and workmen for the purpose of dealing with wages, hours and conditions of employment. In order that there may be no interval between the cessation of the Agricultural Wages Board machinery and the establishment of the new Conciliation Committees, the Bill provides that the representatives of employers and workmen on the existing District Wages Committees shall in the first instance act as joint conciliation committees in their respective districts. The members of the joint conciliation committees will consist solely of representatives appointed by the employers and employed. The committees may appoint an independent person to act as chairman, with or without a vote as the Committee may decide, or may agree to such appointment being made by any Government Department or other body.

When any one of these committees has agreed upon a rate of wages for any class of persons employed in agriculture, the agreement may be submitted to the Minister for confirmation. When confirmed, the particulars are to be advertised in the district in order to bring the terms of the agreement to the knowledge of the persons affected. Where a rate of wages has been so agreed, confirmed and advertised, it then becomes an implied term of every contract for employment that the employer shall pay to the workman wages at not less than the rate payable under the agreement, and such contract will be enforceable at law. Where in any proceedings for the recovery of sums due under any such contract it is proved that on account of special circumstances affecting the workman, the employer and workman have agreed to a lower rate of wages, the court may determine that the wages shall be recoverable at the agreed rate or at any rate the court may think fair and reasonable.

In order to assist the agricultural industry to form district conciliation committees on the termination of the Agricultural Wages Board, the Minister of Agriculture and Fisheries has set up a special temporary branch of the Ministry to deal with the matter. Mr. H. J. Wilson, C.B., of the Ministry of Labour, whose services have been lent by the Minister of Labour, has been placed in charge of it.

* * * * * *

Minimum Prices of Wheat and Oats.

REPRESENTATIONS having been made that the time allowed to growers of wheat and oats in which to make their claims under the Corn Production Acts was too short, the Ministry announced on 28th June that claims might be made up to 18th July, but that no further extension of time beyond that date would be granted. No claim can now be received unless the claimant can show that he became the occupier of the land to which the claim relates after 30th June, in which case a claim will be accepted up to 1st September next.

The total number of claims received up to 18th July is approximately 160,000. These have been sent to the County Agricultural Committees, whose officers are engaged in testing their accuracy: special attention is being given to those cases where there is reason to suspect that the land has been negligently cultivated. The work of inspection is being proceeded with rapidly, but in view of the fact that a very large proportion of the claims were not made until July, the work cannot be completed for some weeks.

The Corn Production Acts (Repeal) Bill proposes that the amount payable in respect of this year's crops of wheat and oats shall be £3 and £4 per acre, respectively, and that payment shall be made on 1st January, 1922, or about four months earlier than would be possible if the Corn Production Acts remained in force.

* * * * * *

Corky Scab of Potatoes.

THE Ministry has noted with regret the large number of cases where seed potatoes affected with Corky Scab (*Spongospora subterranea*) have been sold for planting, and in answer to various inquiries has considered the renewal of the Corky Scab Order which was suspended during the War. The whole position has been examined, but in view of the following facts the Ministry feels that it is at present undesirable to revive the Order.

(1) The risk of large new areas becoming infected appears to be slight. From the Plant Disease Survey organised by the Ministry it is clear that Corky Scab may in certain seasons occur in almost every county. Whilst, therefore, it is always inadvisable to plant diseased seed, there are no large tracts of country, at present clean, which would become infected if such seed were used.

(2) The intensity of the disease appears to be largely a matter of seasonal conditions. The Survey shows that during 1920 Corky Scab was very much more prevalent than usual, and in many of the northern counties it occurred in a particularly severe form. Many soils which in normal years give a clean crop, produced last season tubers badly affected with Corky Scab. On the other hand, badly diseased seed may sometimes be planted and an entirely clean crop result. Although it has not been proved by actual experiment, it appears likely that the conditions leading to severe attacks are a cool soil-temperature and a plentiful supply of soil-moisture during the growing season. Excess of lime also is well known to accentuate attack.

(3) There is great difficulty in the administration of the Corky Scab Order. The disease is not always easy to recognise with certainty, even by experts. In inspecting consignments of seed, slight infections would be easily overlooked, and, owing to the similarity of mild cases to attacks of Common or Brown Scab, examination with the microscope is often necessary. This would entail an increase in the number of inspectors and involve extra expense.

For the present, therefore, the Ministry, although deprecating the use of seriously scabbed tubers for seed purposes, feels that the gain which would be derived by the Order would not justify the additional expense. Purchasers are accordingly advised to examine for themselves the seed supplied and reject all that is extensively or seriously diseased.

* * * * * *

National Institute of Agricultural Botany Yield Trials.

ONE of the most urgent needs of modern argiculture is the provision of a system by which the value of new varieties and strains of farm plants may be ascertained before their general distribution.

The National Institute of Agricultural Botany, organised with the object of improving the seed supply of the United Kingdom, is now making arrangements to conduct a comprehensive series of yield and "quality" trials of cereals (wheat, oats and barley) to commence during the season 1921-22. The trials will be carried out on a uniform and scientific system in several parts of the country, and final reports, on which the granting of certificates of merit will be based, will be issued after the harvest of 1924. The trials will be open to all who can show that they have in their exclusive possession new or improved varieties or strains of any of the above cereals, and who undertake to refrain from placing them on the market before the issue of the final report on their merits, except with the consent of the Institute.

The testing fee will be limited to the actual cost of the trial, which will be determined at the time of the issue of the final report.

At the conclusion of the trials, the whole of the seed will be returned to its owner unless the Institute shall consent to take over the stock on terms to be mutually agreed.

All those interested are requested to apply at an early date to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge, from whom full particulars may be obtained.

* * * * * *

Autumn Cleaning of Weedy Land.

FARMERS do not want weeds, but weeds will grow in spite of him, and even on occasion unknown to him, with the result that he may fail to recognise their presence until they are in full bloom. When this is the case it is likely to be too late to deal with them without considerable expenditure of time and labour.

There is usually a period between the harvesting of one crop and the planting of another during which a war of extermination against weeds may be waged. This year the drought, however lamentable in other ways, should afford special assistance in such a campaign. The hot, dry weather has had the effect of ripening cereal crops earlier than usual, and the interval between harvesting and planting will, therefore be extended.

Full advantage should be taken of this longer interval to clean the land thoroughly. Ploughing, not too deep, or scarifying should follow close behind the reapers, and if a good tilth can be prepared weed seeds will be encouraged to sprout. Directly this takes place (and the rain, when it comes, will be likely to induce rapid germination) the seedlings can be attacked in the mass with cultivators and harrows. Ploughed in, the young weeds will do some good as green manure. Though, in the war on weeds, actual extermination by cultural methods is hardly possible, still, thorough attention while the land is unsown will go far to reduce the amount of horse-hoeing and hand-hoeing required in the future.

Weeds such as couch, field bindweed and creeping thistle, which spread by means of underground runners, naturally require different treatment from weeds which only live for a year. Regarding such, or indeed any weeds, farmers might find it useful to consult their County Agricultural Organisers, whose names and addresses are given in the Ministry's Leaflet No. 279. In all cases, the main effort should be to prevent weeds from growing at all; it is much more expensive to deal with them when they become established than to keep them down season by season. One of the first conditions for clean crops is the use of clean seed.

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Home-grown Wheat Prices, 1920 Crop.

In the May issue of this *Journal*, particulars were given of the arrangements made as regards home-grown wheat prices of the 1920 crop, and in the issue for July, it was stated that for the month of July the average price properly receivable by growers was 82s. per 504 lb.

The Ministry is now informed that the Royal Commission on wheat supplies calculate that the cost of wheat imported during May, June and July is equivalent to 80s. per qr. of 504 lb. for home-grown wheat of sound milling quality. Until 13th August, therefore, the average price properly receivable by growers for home-grown wheat of sound milling quality of the 1920 crop

will be 80s. per 504 lb. *Farmers are reminded that the arrangements as regards British wheat of the* 1920 *crop come to an end on 13th August.*

Taking into account the value of imported wheats of comparable quality on the open market, it is estimated that no refund to millers will be required to ensure on average the receipt of the above price by the grower. The Board of Trade, therefore, will pay no refund in respect of any home-grown wheat, ground after 31st July. Millers are reminded that the undertaking referred to relates solely to wheat of the 1920 crop. Growers who sold their wheat between the 8th November, 1920, and 5th March, 1921, and who have not yet made their claims under the schemes for the fulfilment of the Government's undertaking in regard to the price to be obtained for wheat of the 1920 crop, must make their claims on the prescribed form not later than the 13th August. Claims in respect of wheat sold direct to a miller must be transmitted to the miller for certification, and those relating to wheat sold to a merchant must be certified by the merchant and transmitted by the growers to the local wheat panel not later than the 13th August.

* * * * * *

American Gooseberry Mildew.

As it appears that some misunderstanding still exists as to the present regulations with regard to American Gooseberry Mildew, the following summary of the effect of the Orders now in operation has been prepared for the information of growers and dealers :—

(1) Outbreaks or suspected outbreaks of American Gooseberry Mildew occurring on premises on which gooseberry or currant bushes are grown for sale must be reported to the Ministry. Outbreaks on other premises need not be reported, but the Ministry will be happy to give advice to any grower as to the measures which should be taken for the control of this disease.

(2) Gooseberry bushes affected with American Gooseberry Mildew may not be sold or moved from any premises until all visible traces of the disease have been removed.

(3) There are no restrictions on the sale in England or Wales of any gooseberries (fruit) grown in this country. Berries affected with American Gooseberry Mildew may not, however, be sent to Scotland except under licence from the Board of Agriculture for Scotland.

THE EDUCATION OF THE FARM WORKER.

W. R. SMITH, M.P.

"*The present generation would indeed be surprised if they could foresee what science and brains will do for agriculture in the next half-century*

THIS quotation from an official report seems to be so reasonable a statement that I use it as a peg on which to hang all I have to say in this paper on the very difficult subject of education. It is obvious that the vast changes and developments prophesied in the above quotation will mean that agricultural workers will in many respects be different in the future from what they have been in the past. Whatever viewpoint we may have, most of those connected in any way with agriculture want to see the workers on the land as keen, as alert, and as educated as is possible.

If we use the phrase "education of the workers" in its widest sense, the subject will fall naturally into two divisions. There is, firstly, what is usually described as technical education; and secondly, what we may call social education.

I do not think this matter can be usefully discussed unless we are prepared with an answer to what seems an elementary, though important, question: What object is to be pursued in the education of boys and girls? Let me say at once that I do not subscribe to the view widely held that education is merely for the purpose of enabling the workers to keep pace with industrial developments, and to respond efficiently to the increasing demands made on their intelligence by modern organised production. I believe that the workers have a right to culture as such. They should be free to enlarge their minds, and to fit themselves to enjoy the deep happiness hidden away in books, in music, and in art. It is this conception of the function of education that leads me to make my strongest objection to elementary education as we know it to-day.

It imparts a varying quantity of facts, and gives the scholars some idea how to read and write. *It seldom implants in their hearts a real eagerness to know more.* At an age which should coincide with a crucial period in an educational course, the average rural (and town) child leaves, and is "done with schooling." There is no hunger for more knowledge. The books are laid away, and the child turns to "the more serious business of contributing to the family income."

With a "system" of education which stops short at such results we cannot possibly be satisfied; and those who have the interests of child life at heart must work, in season and out of season, to secure for the workers' children some real education during at least those most important years between fourteen and eighteen, when so many wonderful secrets of life begin to reveal themselves.

I have said that education is a difficult subject to discuss. It is difficult because it has become depressing. In the campaign for economy which has been going on in every quarter, one of the first fields for retrenchment has been that of education. The Education Act of 1918 aroused great hopes; but now we find that all schemes for continuation education not already in operation are indefinitely suspended. Even the county agricultural committees, which by arrangement may take over certain duties hitherto performed by the education committees, have been told by the Minister that "while the last thing in which he wished economy to take place was education," he was obliged to ask them to spend less. The worst economy of all is the attempt to save money on the teachers.

It is with this question of the teachers that we get near the heart of the matter. In the *Farmers' Union Year Book, 1921*, it was declared that "It is unsound to have our rural schools indifferent copies of our urban schools. They must find their inspiration from their rural surroundings and instil a real love of the country and of nature." In short, the schools should have a life and power of their own. Yet how can we expect this when we realise the inadequate provision made for teaching in rural areas? I yield to no one in my admiration of the rural teachers' heroic struggle under adverse conditions, but they, I am sure, will be the first to agree that great reforms are necessary. The disparity between the salaries in rural areas and those paid in towns is too great, with the result that the towns attract the best teachers. This does not, of course, mean that no good teachers find their way into the country. The headships of country schools often attract assistant masters from urban areas. The difficulty is that the county councils, which control the country schools, often have a large number of schools under their charge, and are therefore subject to the strong temptation of having cheap supplementary teachers. Although most head teachers in country schools of seventy to eighty children are certificated, the standard is satisfied very often with either an additional uncertificated teacher or supplementary teacher, or both. The number of teachers

employed by county councils in rural schools is about 50,000, and this number includes 10,926 supplementary teachers! This is an indefensible position. Such economy—penny wise and pound foolish—stands utterly condemned. I do not ask that these uncertificated and supplementary teachers be swept summarily off the board; but I would point out that if they were paid better, and more opportunities for self-improvement given, a higher standard could reasonably be expected. In my opinion, all the costs of education, both "general" and, up to a certain point, "technical" also, should be charges on the national exchequer, for they are incurred in the business of making citizens. Only in this way can all the inequalities which exist between one authority and another be eliminated.

I am quite confident that the view taken in the *Farmers' Union Year Book*, quoted above, is the right one. It ought not to be difficult to relate the everyday life and *thought-development* of children in the country to the world of nature which surrounds them. Experience shows that to an unitiated countryman a beautiful valley may be nothing but a "dull place where nothing ever happens." Of country children it can often be said: "Eyes they have, but they see not!" It is not a matter for wonder that, to such as these, towns, with their kaleidoscopic changes in the daily scene, seem a paradise of movement, whilst the magic ebb and flow of life all through the countryside create no wonder. In some subtle way, without doubt, a man's love for his native place, where he has perhaps spent most of his life will sometimes, but not always, hold him to the land. This, however, is not enough. We need to create in the hearts and the minds of growing children in the country a delight in, and an understanding of their environment. Farm life and work must be not merely endured when no town alternative offers, but must attract both those born on the land and those from the congested cities.

All this implies that life on the land must be no "dead-end" occupation. Avenues of advancement must be there, and, as a corollary, education of every grade, even to the highest, must be open to every village boy or girl who is keen and able to take advantage of it.

On paper there is a system of agricultural education which is truly admirable (though of course needing immense development). In a leaflet issued by the Ministry it is thus described:—

"Briefly, the agricultural education which is now available consists of courses at various colleges extending over three

or four years and leading up to a degree or diploma; shorter courses at the same institutions; short courses varying from a few weeks to several months at farm schools and similar institutions; courses of ten days or a fortnight in dairying at migratory dairy schools which visit a number of different centres each season; and courses of day or evening lectures, accompanied in many cases by practical instruction in agriculture, poultry-keeping, bee-keeping, farriery, horticulture and manual processes. Most county councils offer a number of scholarships, tenable at agricultural institutions, or courses to students resident in the county."

This is very well for agricultural students, farmers' sons, and, perhaps, in some cases, for smallholders. The farm workers, however, are at present scarcely touched by any part of this system. I think it can be said that there is no ordinary agricultural worker at the moment enjoying any of the scholarships referred to above. With the labourer it is the money difficulty that stands in his way: and this could only be satisfactorily solved by a much more generous grant of scholarships. Even if elementary and continuation education were to be widened out to lead a country lad up to a farm institute, money is still wanted. It may be said: " Where there's a will, there's a way," and that if a boy " has it in him " he can get his education. That may be so; but surely a course of education should *be* a course of education, and not a feat of endurance! Money will help; but none appears to be forthcoming, at any rate in anything like sufficient quantities. That is why the present outlook appears to be black. In the face of it one can only urge those who really are friends of education for the country lad, to keep working, in the hope that this short-sighted policy will soon be completely set aside.

It is perhaps nearly as dangerous in agricultural discussions to bring up the question of " rural bias " in early education as it is to bring up that of small holdings. I do not wish to be disrespectful to any experts in education, but I must confess to my belief that the opponents of " rural bias " run to extremes. There are so many aspects of agricultural education—chemistry, botany, mechanics—which can fairly be regarded as valuable elements in a " general " education that I believe the teaching in an ordinary country school could, with great advantage, lean towards agriculture very much more than it does now. In describing the work of the Welshpool County School, the combination of general and agricultural education has been thus referred to:—

"It was considered that it was not the duty of a secondary school to give definite training in the technical and practical processes of agricultural practice, and consequently, in adapting the school curriculum, only those parts of a physics syllabus were retained that were essential to a boy's general training, and had definite application to agriculture."

In general, that appears to me to be an adequate expression of what should be our aim. I suspect that the question of "rural bias" in elementary education is, or has been, largely a bone of contention between two Government Departments, and, in any case, seeing that the Ministry of Agriculture is responsible for all agricultural education other than in secondary or elementary schools, this Ministry should at least be very extensively consulted as to the latter, if anything like a carefully graduated course of instruction is to be built up.

There is one point at which one sees some possibility for action —without undue expense! Surely the text-books provided in country schools, and the general outlines prepared for the courses of instruction, could be devised with an eye to the children's country surroundings. Certainly this would give meaning and interest to much which must appear to ordinary children as ingenious means for making them wretched when they are not allowed to play. And why must all the joy of life be crowded out of school hours? Why is school not an integral and delightful part of the child's life? There must be more opportunity for the study of the great "out-of-doors." Education with "rural bias" and much outside work appears, in spite of jeremiads to the contrary, to be successful in the few secondary schools where it is tried conscientiously and intelligently. Why then are the experiments in this direction so limited?

One must of course realise that the whole theory of teaching in schools is being challenged and criticised. We must wait to see the result of the thousand present discussions, for only a wider experience in educational work would justify one who is not an educational expert proceeding further. Yet I hope I shall be understood, in view of what has been said above, if I venture the opinion that nowhere is there more room for a new spirit and a new outlook in educational methods than in our rural schools.

What I have called *social* education concerns, for the present at any rate, more immediately the *adult* workers in the agricultural industry. By social education I mean the development of thought concerning the history of the worker's class, his

status in modern society, his relation to the community at large, and his prospects and opportunities. I might also include under this head " health "; for though health and sex education should begin in schools they most decidedly should not end there! In the treatment of these subjects, however, with the exception of most aspects of the health problem, we are on dangerous ground, and cannot expect agreement. It is obvious that in teaching history, for instance, bias is bound to give a trend to instruction. Social topics such as those referred to above cannot be presented for discussion as mere collections of universally accepted facts. Points of view must be given, deductions drawn, probable developments indicated, and the right line of effort based on the knowledge gained must be suggested. Similarly, impartiality in teaching economics is unattainable; sociology and class politics are inextricably mixed.

For these reasons the social education of farm workers (and all other workers) should be left to working class organisations. The teaching of history and economics, which is part of the organisation of the present social system, cannot receive the support of the opponents of that system. This position, pushed to the extreme, has been stated in these words:—

> " The workers must think independently. The workers want not merely more education, but a different education. There is no magic that can transform an industrial or political enemy into an educational friend."

The workers have already made small attempts to provide for themselves these educational facilities. One can recognise the limitations, however, which only time can overcome. At present the workers can only get control over adult education to the extent of choosing their subjects and selecting their tutors from among those approved and paid for by universities and local education authorities. The Workers' Educational Association, through its tutorial classes and summer schools, as well as the co-operative movement, provides education of this character for the workers. This dependence must to some extent continue until more workers are able to pass through all the grades of education now provided, or until facilities for independent education are far more numerous than at present. Meanwhile we must remember that schools are not the only channels of education. Books and newspapers are valuable means, and through these we must continually present the workers' case and viewpoint.

Therefore, although we recognise the class character of modern

education, particularly of the higher grades, we cannot reject it on that account. On the contrary, speaking for myself, I am anxious to encourage youth to make the most of existing opportunities. I want to see the way open for them—to farm institute, to agricultural college, even to the university itself.

Though we cannot go so far as we would, the emphasis of repetition must be laid on the fact that *social* education in rural districts, through week-end schools, courses of lectures, summer schools, and the like, must be under the *control* of the workers' own organisations. I conceive it to be part of the duty of modern trade unions to provide, or to assist in the provision of, these facilities.

This much has been said in order that it may be seen that behind the apparent contradiction which may appear to exist in the education views of different sections of the workers, there is at least an understanding of the real position.

There still remains a vast field, as yet unexplored, for co-operation among the various bodies interested in rural education. Every village having a branch of a rural workers' trade union should be able to organise classes for the coming winter. The existence of a branch would at any rate show that there are people interested in *something!* Such classes would arouse interest in the more ambitious schemes for summer and winter schools. It has been said that facilities for any education demanded by farm workers could be provided; that it is not the supply but the demand which is lacking. The economy campaign throws grave doubts on the first part of this statement; but as to the demand, I am convinced it exists, though it has not as yet found opportunities for expression.

We must make a beginning, and doubtless the beginning will be a small one. Why should not the Ministry, the county agricultural organisers, and the unions work together more closely in getting some "technical" classes going? The first two might organise, and the last might advertise them. There would need to be proper courses of instruction, not isolated lectures such as might be given in a Women's Institute or a Village Club. The co-operation would have to be real and complete on both sides. Other courses on social subjects, and on different occasions, might be offered to the same classes, but these would be planned by the workers' organisations.

I suggest that the need for action is urgent and the time for action is ripe. If all parties, without rigidity, would earnestly consider the problem together, we ought to get something done.

ARTIFICIAL FARMYARD MANURE.

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As a consequence of the campaign for increased food production during the War, and the resulting extension of the area under cereal crops, it was thought that, even after making allowances for disposal through the usual channels, there might still remain a surplus of straw which could not be tilised for feeding or for conversion into manure. It was therefore determined to investigate the possibility of converting straw into manure without the intervention of live stock, and a special grant in aid of the investigation was made to the Rothamsted Experimental Station by the late Food Production Department. Apart from war conditions, the possibility of adding to the supply of organic manure deserves consideration. In the case of market gardens particularly. the difficulty of obtaining adequate supplies of stable manure is increasing. The investigations described below indicate a method by which straw can be converted into a substance having many of the properties of stable manure. Further experiments to test the economic value of the process when conducted on a large scale are in progress at Rothamsted. Lord Elveden has also generously provided assistance and facilities for experimental work on his Pyrford Estate.

Of a considerable number of preliminary experiments to secure obvious breakdown and colour changes in fermenting straw, the most promising results were obtained when straw was subjected to the action of a culture of aerobic cellulose-decomposing organisms (*e.g.*, *Spirochaeta cytophaga*). Further enquiry showed, however, that this effect was not due simply to the provision of an organism capable of breaking down cellulose, but rather to the indirect effect of the mineral substances contained in the culture fluid. From this point on, the question of food supply—as distinct from the addition of any particular species of organism—received special attention, and, as will be seen later, led to results possessing both theoretical and practical importance.

Without entering into a detailed account of the various stages of the investigation, we may state here that the most essential factors making for the production of well-rotted artificial farmyard manure are air supply, suitable temperature, and a suitable supply of soluble nitrogen compounds.

(1) *Air supply.*—It has been found invariably that characteristic breakdown changes in straw remain suspended when a free supply of air is excluded either by intense consolidation or by immersion of the straw in liquid. The fermentation appears, therefore, to be an essentially aerobic one, at least in its early stages, and the typical disintegration of the straw with the production of dark-coloured plastic material does not take place in the absence of air. Moreover, the colour of aerobically produced manure is rapidly reduced when oxygen is excluded. The great importance of air supply is shown by the following experiment, in which four lots of straw were fermented under aerobic and anaerobic conditions for three months at 37° C. (99° F.).

	Loss of Dry Matter.	
	Straw without Nitrogen.	*Straw with Nitrogen.*
Without Air Supply ...	16·3 per cent.	17·1 per cent.
With Air Supply ...	40·1 "	59·8 "

The data explain what may be seen in the ordinary heap of farmyard manure, viz., that straw submerged in liquid urine, and therefore protected from air, remains in an unchanged state for long periods. On the other hand, the practice of carting manure from the yards and boxes and storing it in heaps in the field, although carried out for other reasons, provides better conditions for rotting than are likely to prevail where the dung is consolidated by trampling and saturated with urine.

(2) *Suitable Temperature.*—Except in those cases where straw is being fermented under otherwise unfavourable conditions, special measures to maintain a favourable temperature for fermentation are not called for. In common with other fresh fermentable materials, moist straw rapidly undergoes a preliminary fermentation during which the temperature may rise to upwards of 65° C. (149° F.). It is, however, in the subsequent stages that the effect of treatment becomes most evident in maintaining the temperature. Experience has shown that a supply of nitrogen, by increasing the energy of fermentation, leads to an increase of 15—20° C. (59—68° F.) in favour of straw which has received a sufficient supply of nitrogen, as compared with untreated straw.

(3) *A Supply of Soluble Nitrogen Compounds in suitable Concentration, and possessing a neutral or slightly alkaline reaction.*—Repeated experiments have shown that the most rapid breakdown of straw occurs when some source of nitrogen in an available or indirectly available form was supplied, and then only in those cases where the re-action of the solution was neutral or

slightly alkaline. Hence the supply of nitrogen in the ammonium sulphate alone fails to lead to definite breakdown since the medium soon becomes markedly acid, while, on the other hand, the supply of an alkaline compound alone, such as caustic soda, is equally ineffective, since a source of nitrogen is lacking. The addition of nitrogen in the form of urine, urea, ammonium carbonate, or peptone within certain concentrations immediately sets in train rapid decomposition changes, and results within the period of a few weeks in the production of dark-coloured, well-disintegrated, structureless material closely resembling well-rotted manure. That this should be the case with urine was perhaps not remarkable, although the factors which operate in the essential dung-making process had not then been individually worked out, but that an essentially characteristic product could be obtained without the use of urine or of the fæcal portion of the manure as ordinarily produced was at once suggestive. On the basis of subsequent work, it may indeed be claimed that, in the production of normally well-rotted farmyard manure, the mass inoculation of the litter with the large bacterial population of the fæces does not exert any marked contributory influence on breakdown changes; that the urine, as such, apart from being the carrier of nitrogen, does not induce any characteristic changes in the straw, while the typical smell and colour of stale urine from the manure heap may be successfully reproduced from straw treated with ammonium salts.

Although it is important that available nitrogen should be present for the rotting process, it is also not less essential that the quantity of nitrogen should not exceed a definite amount both actually as well as in concentration. In other words, if the concentration of ammonium carbonate produced from the decomposition of urine or urea exceeds a definite limit, not only are straw-breakdown changes definitely held up, but they continue to be inoperative until by volatilisation, and consequently loss of nitrogen to the air, the concentration or alkalinity has been reduced to the upper limit of growth of micro-organisms. *This must be regarded as particularly important, since the highest concentration for rapid breakdown is appreciably below that of the weakest undiluted urine.*

It follows that it is quite impossible to produce well-rotted dung by the use of neat urine without considerable losses. This fact may be illustrated by the following table, and, incidentally, is shown by all the investigations that have been carried out

on the making of farmyard manure.* Three equal portions of straw were saturated either with water or urine and allowed to ferment for three months in the laboratory, the two portions with urine being subjected to different temperatures. As will be seen from the following table, these two portions fermented to different degrees—the dry matter losses being 49 and 60 per cent. respectively, *but the final nitrogen content was almost identical*, and practically three-fourths of the nitrogen supplied as urine was lost.

	Temp.	*Loss of Dry Matter. per cent.*	*Nitrogen. Initial.* mgrm.	*Final.* mgrm.	*Loss − or Gain +* mgrm.
Straw with water ...	(36°C.=97°F.)	40·1	71	97	+26
Straw „ urine ...	(26°C.=80°F.)	49·1	507	178	−329
Straw „ „ ...	(36°C.=97°F.)	59·8	507	176	−331

It would be erroneous, however, to assume that such losses are inevitably connected with a satisfactory breakdown of straw, or that the conditions ordinarily obtaining in the farmyard at all represent optimum proportions between the straw which is to be decomposed, and the concentration of nitrogen in the urine which eventually serves for this decomposition. That equally good rotting may be obtained without loss of nitrogen is shown by the cases given in the table below. In the experiments to which the table refers, straw was incubated with urine in different concentrations for periods up to 86 days. Even after this period the losses that occurred with satisfactory rotting and within the lower concentrations were only about 4 per cent. of the total nitrogen of the final product. The ordinary losses of the manure heap are frequently more than tenfold this amount.

	Number of Experiment. (1)	(2)	(3)	(4)	(5)
At beginning					
Straw and urine nitrogen	77·5	157·6	237·6	317·6	397·6
After 86 days					
Total nitrogen	77·3	153·1	226·8	262·1	308·0

In addition to *the two phases already mentioned*, (*a*) in which straw overloaded with nitrogen loses it to a definite degree, and (*b*) in which straw with the requisite amount of nitrogen may undergo rotting without appreciable loss and is therefore in a state of equilibrium, there exists *a third phase* in which under-saturated straw, by the agency of micro-organisms, exhibits a well-marked property of picking up nitrogen, particularly in the

* See, for example, Russell & Richards, *Journ. Agric. Sci.*, 1917, Vol. VIII, p. 495.

form of ammonia, until the same final content of nitrogen in the rotted product is attained. Hence we might expect that in two different but adjacent portions of fermenting straw, the one overloaded with, and the other lacking, nitrogen, the former portion loses and the latter accumulates nitrogen until a common level is approached. That such is actually the case is

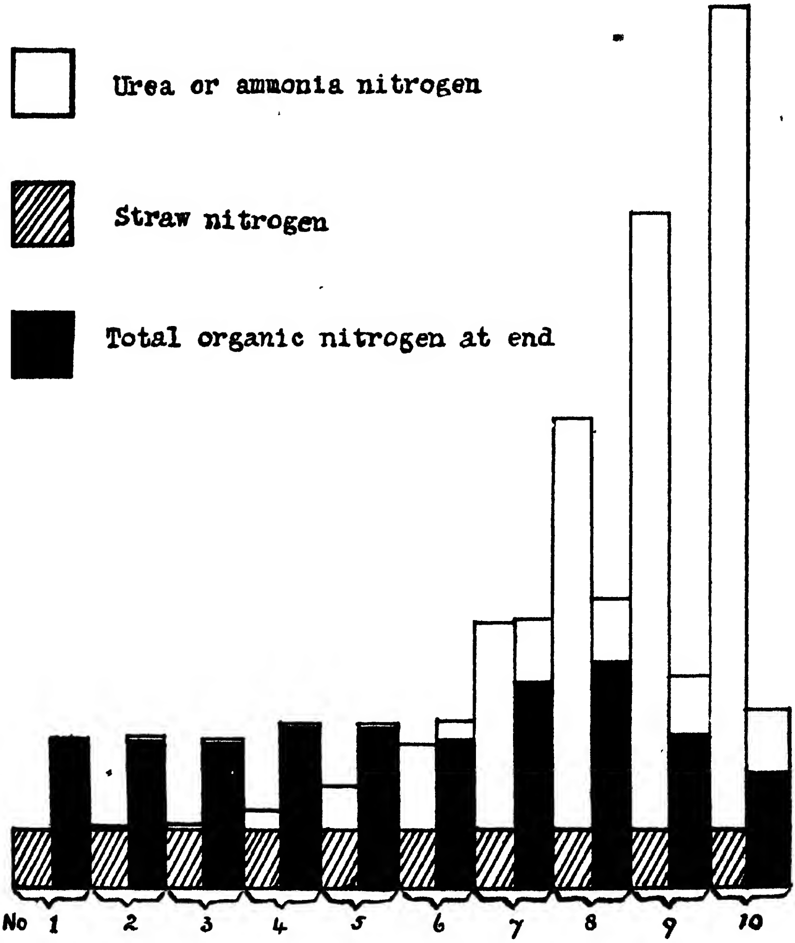

FIG. 1.—The diagram illustrates the power of under-saturated straw to pick up Ammonia lost by super-saturated straw. Ten portions of straw with increasing quantities of nitrogen (as urea) were allowed to ferment for three months.

illustrated by the following data, and is diagramatically represented in Fig. 1. Ten portions of straw were moistened to the same extent, and while one received water only, the others received additions of soluble nitrogen in the form of urea in

varying quantities, until the last portion was saturated with a solution similar in concentration of nitrogen to that of horse urine (1 per cent. of nitrogen). The different portions were then kept in an incubator for 3 months, at the end of which time it was evident that, contrary to expectation, the straw, without, or merely with low doses of nitrogen, had passed through a marked rotting process. On analysis, however, it was found that there had been a definite accumulation of nitrogen in the lower members of the series, while the higher members had lost in some cases the greater portion of their original nitrogen.

The Decomposition of Straw in the Presence of Varying Quantities of Nitrogen as Urea.

	Number of Experiment.									
Treatment	1	2	3	4	5	6	7	8	9	10
At beginning										
Straw nitrogen mgrm.	71	71	71	71	71	71	71	71	71	71
Urea nitrogen „	—	5	10	24	48	97	243	486	729	973
Total nitrogen „	71	76	81	95	119	168	314	557	800	1044
At end of 3 months										
Organic nitrogen mgrm.	180	177	174	190	192	171	245	269	181	134
Ammonia „ „	—	5	2	4	4	29	74	68	71	76
Total „ „	180	182	176	194	196	200	319	337	252	210
Gain or loss— „	109	106	95	99	77	32	5	—220	—548	—134
Dry Matter, loss per cent.	49	46	45	49	47	53	51	48	19	14

In seven out of the ten cases the final nitrogen of the fermented straw varied only between 180 and 210 mgrm., irrespective of the nitrogen content of the original mixture. It should also be noted that the extent of the rotting, *i.e.*, the loss of dry matter, in experiments 1—8 was very much greater than in 9 and 10 in which the straw was subjected to the action of solutions closely approaching the concentration of ordinary urine, the high alkalinity of the latter exercising a check on decomposition.

In the main, the nitrogen retained by super-saturated straw, or such as is accumulated by under-saturated straw, as in Nos. 1—6 in the above table, appears to be stored up in an organic or non-ammoniacal form. The maximum retention has been found to occur within the first four weeks, after which time breakdown of this organic nitrogen to ammonia and consequent loss by volatilisation seems to keep pace with loss of dry matter. Finally, the material assumes a "stabilised" condition—the loss of nitrogen becomes greatly diminished or may be absent altogether for long periods. These three phases—accumulative, dispersive and stable—are shown in Fig. 2, which illustrates the type and extent of the changes taking place in a mixture of straw and urine during a period of four months.

Between the 60th and the 120th day little change is found to take place either in the amount of "stabilised" or "fixed" nitrogen or the proportion of this nitrogen and the ammonia which appears to be held by fermented material even at a high temperature (37° C. = 99° F.), and in spite of the frequent handling and exposure associated with sampling operations. In general, it may be stated that when straw has worked from an

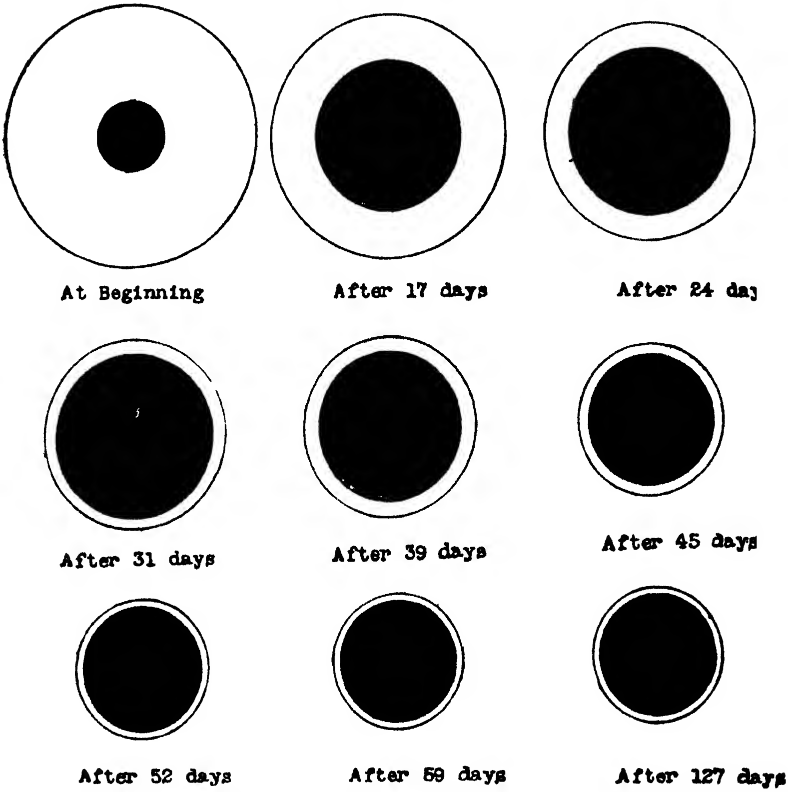

FIG. 2.—The diagram illustrates the changes that occur when straw is fermented in the presence of urine. The black discs represent fixed nitrogen, and the white outer circles represent ammonia nitrogen.

unsaturated to a "stable" phase little or no free ammonia is to be found, but straw which commences with a super-abundance of nitrogen appears to hold, when in a fermented state, upwards of 14 per cent. of its nitrogen in the form of ammonia so long as the material is in a moist condition. Desiccation leads almost to complete loss of ammonia, and in this respect as well as in the proportion of ammonia in the moist material, the artificial resembles the natural manure.

From the study of the inter-relations between nitrogen and straw, we have come to the conclusion that the amount of nitrogen necessary for pronounced rotting, and the amount which straw is capable of " fixing " in the form of ammonia are identical, and that, in general, the figure varies only between 0.70 and 0.75 parts of nitrogen per 100 parts of dry straw. Within these limits fermentation proceeds without loss of nitrogen, and it is obvious that, except in so far as the nitrogen content of the original straw varies, the final " stabilised " product obtained when rotting has proceeded to the extent of 40 to 45 per cent. of dry matter must likewise exhibit comparatively slight variation in its nitrogen content. In our experiments the " stabilised " product obtained from the fermentation of straw under a variety of conditions possesses a nitrogen content of about 2 per cent. calculated on the dry material.

It thus becomes possible to estimate fairly accurately what the nitrogen content of any particular sample of fermented straw will be when rotting has proceeded to an appreciable extent. If, for example, the nitrogen content of the original straw is equal to 0.50 per cent., and we assume that the theoretical amount of ammonia nitrogen, equal to 0.72 lb. of nitrogen for 100 lb. of straw, has been fixed, then, with a loss of 40 per cent. of dry matter during fermentation, the resultant rotted straw will contain $(0.50 + 0.72) \times 100 \div 60 = 2.03$ per cent. of organic nitrogen in the dry matter. An additional amount of ammonia nitrogen would probably result in a portion remaining as free ammonia which, as indicated above, would be liable to loss if the fermented straw were allowed to become dry. The data thus obtained enable us to turn to the process of inducing the fermentation of straw on a large scale, and are also capable of application to the conditions operating in the production of ordinary farmyard manure.

Suggested Method for the Preparation of Artificial Manure. *—As regards large scale work, a number of factors have to be taken into account which did not operate in the laboratory experiments. Experience has shown that urea and ammonium carbonate are the most suitable carriers of nitrogen since they ensure a favourable alkaline reaction, and lead to rapid breakdown, provided that they are not present in large excess. They are, however, far too expensive at the present time to admit of general use in farm work, although a reduction in the cost of

* This process, as well as its application to the purification of sewage, has been covered by Letters Patent (British Pat. No. 152387).

manufacturing synthetic urea would create conditions favourable to its extended use. As an alternative source of nitrogen, cyanamide (nitrolim) and sulphate of ammonia have been used with success. Whilst cyanamide already contains sufficient free lime to keep in check any acid compounds formed during fermentation, sulphate of ammonia must be supplemented by the addition of a base, and for this purpose finely-ground chalk, ground limestone, or waste lime from causticising plant at soap works may be used. For general purposes it will be found that upwards of ¾ cwt. of sulphate of ammonia and 1 cwt. of finely divided carbonate of lime per ton of straw are sufficient to induce fermentation. The main obstacles to large scale operations at the present time arise from the great tardiness with which raw straw takes up the moisture necessary for fermentation. Where pits are available this difficulty may be overcome by allowing the straw to remain immersed for 2 to 4 days, after which the free liquid may be drained off. In the case of heaps or stacks on open ground no advantage appears to be obtained by continued wetting with large quantities of water, and we suggest, as a more effective method of securing the necessary saturation of the straw, sprinkling the heap comparatively lightly with water and allowing a couple of days to elapse before a second sprinkling is given. During this time a slight fermentation with increase in temperature sets in, rendering the straw more capable of absorbing a second slight application of water than would otherwise be the case. When examination has shown that the interior of the heap has become uniformly moist, the source of nitrogen may be applied in the form of solution, or in the case of cyanamide and other products, this may be broadcasted over the surface of the heap and watered in. The moist convenient method of making the heap, wetting the straw, and supplying the necessary nitrogen for fermentation depends so much on local conditions that much must be left to the initiative of the farmer himself.

General Characteristics of Artificial Farmyard Manure.—Artificial farmyard manure prepared from straw is a well disintegrated plastic material in which the tubular character of the straw has been to a great extent destroyed. There is an almost complete absence of smell, the little there is being slightly fusty or mouldy in character. When prepared through the agency of a compound in the presence of free lime, there is a tendency towards the production of a blackish colour, while if prepared from soluble alkalies such as ammonium carbonate, liquid

ammonia, or compounds giving free ammonia such as urea or peptone, or in the presence of sodium hydroxide or sodium carbonate, the colour is dark brown, and differs only slightly from the natural product. The liquid, which is gradually expressed from the fermenting straw as more and more dry matter is lost by fermentation, has a dark brown colour and a smell which is indistinguishable from stale urine.

Application of Results to the Production of Ordinary Farmyard Manure.—Since it has been possible to produce material identical in physical properties with well-rotted farmyard manure, differing only in chemical composition in so far as the latter contains appreciable quantities of phosphorus and potash derived from foods consumed by the animal, the possibility suggested itself that the results might be applicable to the making of ordinary farmyard manure and led to an inquiry in this direction.

Of the three constituents ordinarily present in manure—urine, fæces and straw—the fæces appears to contribute to the physical character of the product only, since manure can be produced without their presence. Moreover, definite experiments have shown that, chemically, fæcal nitrogen is to a great extent inert and is not capable of contributing to the decomposition of straw to any degree comparable with urine nitrogen. On the contrary, certain methods of feeding farm animals, and particularly of horses, sometimes lead to the production of fæces containing quantities of readily available carbohydrates, and it has been shown* that such fæces are capable of supporting the fixation of atmospheric nitrogen. There is every reason to suppose, therefore, that the fæcal portion of the manure heap inclines slightly in the direction of itself requiring nitrogen rather than acting as a source of nitrogen for the decomposition of straw. With the above exception of some horse fæces, the solid excrements of farm animals may be regarded as having reached a state similar to that observed above in fermented straw, *i.e.*, containing roughly 2 per cent. of nitrogen in the dry matter. This is borne out by the following mean figures which have been obtained from various sources:—

Horse fæces	(mean of 8 records)	= 2·00	per cent. N. in dry matter.
Cow	(„ „ 11 „)	= 1·88	„ „ „ „
Sheep	(„ „ 7 „)	= 1·92	„ „ „ „
	Average of 26 records	= 1·93	„ „

We thus see that during the process of digestion, and also possibly by virture of bacterial action in the intestinal tracts, the

* *Jour. Agric. Sci.*, 1917, Vol. VIII, p. 299.

percentage of organised nitrogen closely agrees with the figure repeatedly found for fermented straw to which purely mineral nitrogen was supplied, and subsequently converted by a bacterial action into organised nitrogen.

Since evidence of this stabilised condition is found in the product of the fermentation of straw and urine, and also in the undigested portion of food passing through the animal, it might be expected that comparable conditions would prevail in the manure heap. Despite the fact that the manure heap usually consists of the liquid and solid excrements of different animals fed with widely different diets, together with litter of various kinds and in variable proportions, and that this mixture is allowed to mature under conditions absolutely lacking in uniformity, the majority of the available data regarding the composition of farmyard manure indicate a striking similarity in the percentage of fixed or "non-ammoniacal" nitrogen. Without giving details of the methods of feeding or of the conditions under which the manure was produced, it may be sufficient to state that the mean content of fixed or organised nitrogen in manure made under controlled conditions in America, on the Continent, and in this country, proves to be 2.09 per cent. as a mean of 43 records. We are now in a position to appreciate more accurately the character of the changes which proceed during the making and storage of manure. Repeated experiments carried out during the last three decades have shown that during this process a very considerable proportion of the nitrogen originally contained in the food and litter is almost invariably lost, and this loss, which may amount to upwards of 40 or 50 per cent. of the whole, appears to fall largely, or even exclusively, on the urine nitrogen, i.e., the most valuable nitrogen, since it is the most readily available constituent of the manure. To prevent or reduce this loss both chemical and physical measures have been suggested, all of which have proved either ineffective or have interfered seriously with the rotting process.

If dung-making be regarded as essentially a straw-rotting process it is possible to obtain some explanation of much of the loss which has been found to occur. We have seen that the nitrogen-fixing power of straw is strictly limited, and that any surplus nitrogen in the form of ammonia is liable to loss by evaporation. It may therefore be assumed that the practice of supplying concentrated feeding stuffs to farm livestock merely

results in an increased production of soluble nitrogen, which, owing to the normally overloaded condition of the litter, is liable to relatively greater loss than where such feeding stuffs are not used.

We have attempted to test the accuracy of this view by computing the amount of nitrogen that ought under ordinary conditions to be recovered in the form of manure from any given system of feeding. For this purpose we have taken:—

(*a*) the total amount of nitrogen contained in the straw used as litter; this is apparently not in a form liable to loss;

(*b*) the amount of indigestible or fæcal nitrogen as calculated from the digestion co-efficients of the foods consumed;

(*c*) the amount of nitrogen which the quantity of litter employed should be theoretically capable of retaining, *i.e.*, 0·72 lb. of nitrogen per 100 lb. of straw; and,

(*d*) the amount of nitrogen present as ammonia at the end of the experiment; this quantity is extremely variable and is determined by the actual conditions, aeration, exposure, and the length of the period during which the manure is stored.

The application of this method to the actual results obtained in a number of feeding experiments shows that a fairly close approximation may be obtained.

Two instances may be given, the first relating to Professor T. B. Wood's experiment at Cambridge,* and the second to that of Professor Hendrick† on the feeding of bullocks on roots and straw. The following table gives an extract of Professor Wood's data relating to the amount of total and digestible nitrogen supplied to the respective sets of animals, and the net amount excreted after deduction of the calculated nitrogen due to the live-weight increase of the animals. As the animals were not fed with straw but were able to pick over that supplied as litter, it has been assumed that one-quarter of the whole would be consumed, and due allowance has been made for this. In the two instances, therefore, after making this deduction, 41.15 and 83.85 lb. of nitrogen were supplied to the animals, whilst only 30.9 and 46.70 lb. were recovered in the manure. The totals obtained by calculating the indigestible or fæcal nitrogen, together with that contained in the litter and the amount which this litter is theoretically capable of fixing, closely approach those obtained by actual analysis of the manure, being 33.6 as

* *Jour. Agric. Sci.*, 1907–08, Vol. II, p. 207.
† North Scot. Coll. Agric., 1918, Bull. No. 22.

against 30.9 lb. and 46.51 as compared with 46.70 lb. in the two cases respectively.

	No Cake.		*Cake.*		
	Total Nitrogen.	*Indigest. or Fæcal Nitrogen.*	*Total Nitrogen.*	*Indigest. or Fæcal Nitrogen.*	
	lb.	lb.	lb.	lb.	
Mangolds	17·6	4·0	17·6	4·0	
Hay	21·3	8·5	21·3	8·5	
Straw	9·0	1·7	8·6	1·65	(¼ taken as food)
Cake	—	—	42·8	5·56	
Total Nitrogen *minus* nitrogen in live-weight increase.	41·15	14·2	83·85	19·71	
			Calculated.		
Fæcal nitrogen	—	14·2	—	19·71	
Straw "	—	7·3	—	7·0	
Nitrogen fixed by litter ...	—	10·2	—	9·8	
Nitrogen found as ammonia...	—	1·9	—	10·0	
Total (calculated)	=	33·6	=	46·51	
Total actually found	=	30·9	=	46·70	

The data referring to Professor Hendrick's experiments are contained in the table below in a somewhat condensed form. The total amount of nitrogen supplied to the animals as food amounted to 613 lb., and of this it has been calculated that 42 lb. were retained by the increase in live-weight of the animals, thus making the total amount which should have been present in the dung equal to 671 lb., whilst only 524 lb. were actually recovered as organic and ammonia nitrogen. For the calculation, we have taken the fæcal nitrogen as given by Professor Hendrick as 276 lb., the nitrogen contained in the litter as 100 lb., and the amount of nitrogen which would be fixed by the litter (equal to 146 cwt. with a dry matter content of 91 per cent., as 107 lb. It will be seen that the sum thus obtained is 537 lb. by calculation, as against 524 lb. by analysis. It should be noted, however, that Professor Hendrick himself calls attention to the fact that the cattle used in the experiment did better than might have been expected from accepted scientific standards of digested litter, and raises the question as to whether the foods actually used were not more digestible and of higher starch value than is allowed in Kellner's tables. If this were the case, it would simply mean that the amount allowed in our calculation as indigestible or fæcal nitrogen is somewhat too high, and would consequently bring the totals of the analytical and the calculated amounts into still closer agreement.

Analytical Data.		lb.	*Calculated Data.*		lb.
Nitrogen supplied in food	=	613	Indig. (fæcal) nitrogen...	=	276
Nitrogen „ „ litter	=	100	Nitrogen in litter ...	=	100
			Nitrogen fixed by litter (16·352 lb. @ 91 per cent. dry matter × 0·72, *i.e.*, fixation constant)	=	107
Total nitrogen	=	713	Nitrogen as ammonia ...	=	54
Total nitrogen recovered in dung	=	524	Total calculated	=	537

Similar calculations have been made in the case of other feeding experiments, but these two instances will probably suffice to show that the amount of nitrogen which we found straw to be capable of fixing in the laboratory, is also most probably built up into organic form and to the same extent under ordinary farm conditions. It is, perhaps, outside the scope of this paper to suggest means by which the observed losses which occur in the making of manure may be minimised, but rational practice would appear to lie in the direction of a more liberal use of litter in order to increase the amount of ammonia that can be fixed, with the further result of a considerable increase in the dung-making capacity of a given number of stock.

THE CLAYING OF FEN SOILS.

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THE true fen soils of East Anglia, or "Blacklands" as they are called, are light soils, black in colour, containing a very high percentage of organic matter, the mineral matter present being mainly coarse and fine sand, only a very small percentage of the finer particles being present. Even the top soil may contain over 50 per cent. of organic matter, and in the subsoil the high organic content is even more marked, until a layer of unadulterated peat is struck, sometimes within a foot of the surface. This layer of peat may be only a few inches in thickness, in which case the local name of "Bears' Muck" is given it, or it may continue to a depth of several feet. Under this peat is either sand and gravel, or clay, and on this the value of the land depends. Blackland overlying clay is superior in every way to that overlying sand and gravel, and if the clay is within four feet of the surface, then the process of claying the top soil is rendered cheaper and the land has an increased value.

Historical.—The practice of claying fenland is undoubtedly an ancient one, though exactly when and where it had its origin it is impossible to say. Arthur Young, in his *Lincolnshire*, written in 1799, does not mention it, from which it may perhaps be assumed that it was not then a common practice. Samuel Wells in his *History of the Drainage of the Great Level of the Fens*, 1830, gives an interesting note on this subject in which he says: "This mode of management is so very modern, that the author finds some difficulty in giving an accurate description of its singular process." He continues, "The object is to give solidity to the land; but it is for experience to prove whether the heavier soil will not force itself back before the industrious owner can reap the reward of the expense he has thus unavoidably incurred. One beneficial effect, undoubtedly, arises from the measure—the employment of the poor."

In 1841 Mr. Morton, writing in the *Journal of the Royal Agricultural Society*, says: "This mode of improving peaty soils

extends over a very large district, indeed it is equal in extent to the extent of the fens, for, although the whole of the Fenland in Lincolnshire, Northamptonshire, Huntingdonshire and Cambridgeshire has not been so treated, there is scarcely a farmer but what has, and is now proceeding with this most important improvement. I have witnessed this operation for the last 15 years; and I believe it was begun long before." Skertchly in his *Fenland*, 1878, refers to the practice as having been in much favour for the past 20 years.

As the cost in 1841 was estimated by Mr. George Cooke, manager of Lord Harrowby's Lincolnshire estate, at only 54s. per acre, the increase in yield of wheat obtained being 10 bushels per acre of 10 per cent. heavier grain, the improvement to last 15 years, it is hardly to be wondered at that the practice increased rapidly. As the price of corn rose, so claying grew in popularity, for the increased cost of labour was small in comparison.

With the decline in agriculture the practice was gradually discontinued by the smaller tenant farmers, but it was kept alive by the larger farmers, many of whom owned their holdings. For some years before the War it was again growing in favour. With the extreme scarcity of labour during the War all operations of this nature were of necessity stopped, and it was only during the winter of 1919—1920 that it was recommenced to any extent. Indeed, with the very high cost of labour, and the uncertainty of the outlook, the wonder is that it was recommenced at all, and it argues well of the practice that it should be those men who had had most experience of it in the past who were the first to restart.

Objects.—Claying is usually done in the winter months, when other work on the farm is slack, and the field selected has generally carried corn the previous year. The objects aimed at are:—

1. To apply a maximum amount of clay to the surface soil with a minimum of labour.
2. To avoid burying any of the "made" top soil, but to conserve it on the surface.
3. To replace the clay removed, refilling the trenches with inert peat, material which it is useless to incorporate with the top soil (which already contains excess of organic matter), but which, being of a porous nature, will assist drainage.

Method of Claying.—Operations are begun by opening furrows with a horse plough 13 yards apart and parallel to each other. It is usual to plough 2 furrows 10 to 12 in. in width, leaving 12 in. of unploughed land in the centre, thus making the trenches roughly 3 ft. wide at the top. The workman begins at one end of a furrow by sinking a hole about 5 ft. long and 3 ft. wide. The top soil is laid on one side of the hole; the peat from the first hole is piled at the end of the furrow. The clay, which lies directly under the peat, is struck at various depths from 2 to 6 feet. If the clay is deeper than 6 feet, then the operation becomes difficult and expensive, and will not as a rule be attempted. From three to four spits of clay (3 to 4 feet) are then thrown out into heaps, half on one side of the hole and half on the other. The sides of the hole are undercut to some extent, so that the maximum amount of clay may be obtained from each hole. Holes are then sunk all up the furrow, about 1 foot apart, the space being left to shore up the sides of the trench and keep them from caving in; also to act as a dam to prevent the water, which rapidly accumulates in each hole as it is dug, from filling the trench. In digging the second hole the top soil is laid on one side as before, but the peat is thrown into the first hole, and thus the useless material dug from each hole helps to fill up the preceding one.

It is the custom among some farmers to cut away the partition left between each hole after the clay has been removed and the partition has served its purpose. In this way a continuous trench is made across the field, so that as it is filled with porous peat it acts as a drain, which discharges its water at either end into the dykes surrounding every field. This practice seems to be thoroughly sound and may be commended to the notice of those who are not at present in the habit of carrying it out.

Having completed several holes, the workman goes back and spreads the heaps of clay evenly over the land to a distance of 6 yards on each side of the trench.

The tools used are an ordinary spade for clearing away the top soil and peat, a fork for spreading the clay, a small light wooden shovel or spoon with a thin sharp cutting edge and about 12 to 14 in. deep, for digging the clay, and a large wooden scoop for throwing out the water as it accumulates in each hole back into the preceding one. The amount of water

Fig. 1. Digging the Clay, which is 4 ft. below the surface

Fig. 2. The Clay spread, and Trench ready for filling in

met with varies greatly; where there is much to be contended with it renders the operation difficult and expensive.

The clay having been excavated and spread over the whole field, the work of filling in the trenches is begun. Three furrows are ploughed round each trench, usually with a digging plough, to a depth of 8 or 10 inches. After the third furrow has been turned the plough is followed by a gang of men with spades, who remove about 12 inches of subsoil and peat from the bottom of the furrow, and throw it into the open trench. The plough follows and turns a fourth furrow, the bottom of which is dug out and thrown into the trench as before. This process is continued until the trench is filled in. By this ingenious method, known locally as subsoiling, the top soil remains on the surface, and the trench is filled with peat. The whole field is then ploughed. the clay being buried to a depth of 6 inches. The cultivator follows, and the land is prepared for a crop of potatoes or mangolds in the usual way, roots being usually the crop chosen to follow an application of clay.

Cost.—The digging of the holes and the excavation and spreading of the clay is done by skilled "Toolmen" by piece-work. The cost varies with the depth of the clay and the amount of water present in the soil. Prices ascertained in the winter of 1919—1920 varied from 11s. to 15s. per chain of trench dug. The cost of claying per acre in that particular season was approximately as follows, clay being struck at a depth of 4 feet, and water not being excessive:—

	£	s.	d.
Setting out work with plough	0	6	0
Cost of digging holes, excavating and spreading clay, trenches 13 yd. apart, @ 12s. per chain, *i.e.*, 17 chains @ 12s.	10	4	0
Cost of filling in (subsoiling), including plough	2	10	0
	£13	0	0

The work is hard and requires a good deal of skill, and the "Toolmen" earn from 9s. to 10s. per day of 7½ hours. Wages are always rather higher in the fen country than in the surrounding districts, but most of the work is done by the piece. In fact, the amount of piece work is a characteristic of fen farming, the result being a more efficient and better type of labour, as under thi system men earn what they are individually worth. A "Toolman," that is a skilled man, in the

prime of life is nearly always at piece work either dyking, claying, manure carting and spreading, hoeing, or harvest work, the horses being worked mainly by lads.

Duration of the Claying.—For the purpose of valuations of Tenant Right, claying is valued on a seven-year basis, but this is generally admitted to be a very conservative estimate. George Cooke, already mentioned above, estimated claying to last for 15 years, and provided it has been well done, there is no doubt that its effects may be seen for 20 years. The full benefit is not felt until the second year, by which time the clay has become thoroughly incorporated with the soil. During the first year much of the clay may be observed lying on the surface in small lumps.

After a period of 15 years the operation may generally be repeated with profit. By that time most of the clay will have been washed through the top soil. Indeed, the writer has known fields which have been clayed 3 and 4 times at intervals of from 15 to 20 years.

Benefits of Claying.—As regards the benefits derived by various crops from claying, exact figures are wanting, but it is safe to say that both quantity and quality are affected. It is a fact that originally, when these lands were first reclaimed and brought into cultivation, the first improvement carried out after draining was the application of large quantities of clay. Without such an application it was found impossible to grow wheat at all, while oats yielded but a poor, light crop. Practitioners have declared to the writer that their potato crops were increased by 2 tons an acre after claying, and mangolds considerably more. Heavy crops of corn will stand better on land which has been recently clayed, and this point is of first importance in a district where the greatest bugbear to the farmer is a laid crop.

It is by no means easy altogether to account for the great benefit derived by fenland from a heavy application of clay. There is no doubt that several factors are involved. That the action is neither entirely chemical nor entirely mechanical is certain. It has been held by some writers that the clay supplies lime, in which the top soil is deficient. A glance at the analyses given below of two typical blackland soils, with their underlying clays, will show that the top soil already contains plenty of lime, and that the clay contains only a very small percentage. In exceptional cases where the top

soil is acid, the small amount of lime in the clay will have a beneficial effect, yet, generally speaking, there is no deficiency of lime in the top soil to make up.

The potash supplied by the clay is a factor which must be considered. In experiments on the manuring of blackland

Mechanical.	I. *Top.*	I. *Sub.*	I. *Clay.*	II. *Top.*	II. *Sub.*	II. *Clay.*	IIa. *Clay.*
Fine Gravel			·35			1·9	6·5
Coarse Sand			1·87			41·7	10·0
Fine Sand			18·37			35·2	16·0
Coarse Silt			25·50			6·9	6·0
Fine Silt			9·8			1·2	17·3
Clay . ..			19 6			4·2	30·9
Loss on Ignition .	57·30	73·6	12·9	50·3	61·5	3·8	9,1
Moisture	11·0	1 1	3 8	9·0	11·6	1·0	3·16
Chemical							
CaO . ..	5·8	6·2	3·2	18·7	12·4	·3	3·5
MgO	·31	·02	·34	·36	·15	·05	·63
K_2O	·14	·44	·75	·65	·48	·11	·71
P_2O_5	·19	·10	·22	·24	·11	·14	·10
Insoluble Residues ..	23 75	16·80	76·50	25·5	15·65	91·95	

carried out between 1898 and 1907 by the Cambridge University Department of Agriculture, it was found that no benefit was gained by the potato crop from the addition of sulphate of potash to other artificial manures. This is borne out by experience, for the almost universal dressing for potatoes

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on this land consists simply of from 8 to 10 cwt. per acre of superphosphate, no potash manure being used.

Of all the benefits, however, the most important seem to be consolidation and drainage. With soils containing only 20 to 25 per cent. of mineral matter, and from 50 to over 70 per cent. of humus, the consolidation effected by an application of upwards of 100 tons of clay per acre is obvious.

It may be noted here that Clay No. II in the analysis is really not clay and contains over 70 per cent. of coarse and fine sand. This is realised by the farmer to be very inferior material, but running through it are veins of Clay No. II *a*, which, as may be seen by the analysis, is a very superior clay, containing over 50 per cent. of the finer fractions.

The solidity given to these blackland soils by a dressing of clay is quite remarkable. As Mr. Pusey says, in the *Journal of the Royal Agricultural Society*,* "In wet weather, even on a stubble, a horse will often sink in to the fetlocks; yet where so slight a dressing of clay as 40 cartloads per acre has been applied in the previous winter, he will find a firm footing."

In the opinion of the writer the much improved drainage resulting from the modern method of claying already described, is one of the greatest benefits derived from it. In sinking a dyke across a field it will be found that the water table in the centre of the field is very much nearer the surface than it is at either side, where it is lowered by the proximity of the open drains which surround every field. It is clear that a series of trenches 13 yards apart, 6 ft. deep, filled with a porous material such as peat, and discharging into open drains at each end, will assist the free movement of water through the soil and improve the drainage. This point should be borne in mind by those who contemplate carrying out work of this nature.

Owing to the very high percentages of humus it was found impossible to make mechanical analyses of the top and subsoils.

* *Jour. Royal Agric. Soc.*, Vol. II, p. 409.

THE EFFECT OF CHALK ON THE CULTIVATION OF HEAVY LAND.

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IT has long been known in a general way that chalk or lime facilitates the cultivation of land, but so far as we are aware no field measurements are on record to show the magnitude of the effect. In the winter of 1912-13 large plots of land were chalked at Rothamsted, but strips of unchalked land were left in each field for purposes of comparison. Records have been kept of the crops; these are given in Table I and show as a result of chalking an increased yield of clover, which reacts on

TABLE I.—*Effect of Chalking on Yield of Crop. Chalk applied November*, 1912, *to March*, 1913.

Year.	*Sawpit Field.* Crop.	*Yield per acre on* Unchalked.	Chalked 20 loads per acre.	Chalked 50 loads per acre.	*Gt. Harpenden Field.* Crop.	*Yield per acre on* Unchalked.	Chalked 20 loads per acre.
1914	Oats, bush. ...	44·6	37·3	41·1	Potatoes, tons	9·3	8·8
1915	Clover, cwt....	19·4	35·8	39·2	Barley, bush.	36·2	33·9
					Straw, cwt. ...	19·1	18·9
					Wheat, bush.	20·9	19·6
					Straw, cwt. ...	21·4	20·5
1916	Wheat, bush	27·8	33·8	30·2	Wheat, bush.	31·7	27·3
	Straw, cwt. ...	33·0	40·3	35·0	Straw, cwt. ..	39·7	37·3
					Oats, bush. ...	31·4	38·5
					Straw, cwt. .	20·0	25·6
1917	Oats, bush. ..	25·8	29·7	27·1	Wheat, bush.	24·5	27·7
	Straw, cwt. ...	23·4	22·8	22·9	Straw, cwt. ...	18·5	20·1
1918	Wheat ..	Plots not separated.					
1919	Wheat ...						
1920	Oats						
1921	Potatoes ...						

subsequent crops, but there is no increase in wheat, oats or potatoes, apart from that due to the growth of clover. On the

old four-course rotation the gain would have been obvious, but now that the rotation is widened to one of six courses or more, it is less evident.

The ploughman always declares, however, that he can tell by the ease of working where the chalk is applied, and during the past six years attempts have been made to devise some means of measuring the benefit obtained. So long, however, as we were working with horse implements no success resulted. Recently a tractor has been substituted for horses in the main work of cultivation, and among its advantages is the fact that its work can be exactly measured and recorded. These measurements are of great economic importance because the farmer pays direct for every additional pound on the drawbar pull. The Rothamsted Experimental Station is endeavouring to secure its own dynamometer, but so far no satisfactory implement is on the market. For the present purpose, however, we were fortunate in interesting the Hyatt Roller Bearing Co., and in borrowing from them, not only their high class dynamometer, but also the services of their Engineer, Mr. J. L. Bent, who took the measurements and calculated the results.

The particular field on which the measurements were made is Pastures Field (also called Sawpit Field), which had been ploughed in October, 1920, immediately after the oat crop was removed. It was cross-ploughed in March last to a depth of 7 in., using an Austin tractor, and for part of the work a Ransome three-furrow plough, for the remainder a Cockshutt three-furrow plough. The measurements recorded in Table II were taken during this cross-ploughing.

The figures show that chalking not only increases the speed of ploughing but considerably reduces the drawbar pull, so that the cultivation is effected by the expenditure of less work and therefore of less petrol and less wear and tear on the tractor and implements. The increase in speed in the case of the Cockshutt plough is from an average of 2.18 to one of 2.23 miles per hour: in the case of the Ransome plough from 1.98 to 2.21 miles. The drawbar pull fell from 1,538 lb. to 1,358 lb. for three furrows with the Cockshutt, and from 1,610 to 1,425 lb. for three furrows with the Ransome plough.

The average of all results is a saving of 180 lb. drawbar pull and an additional mile of ploughing in every 9 hours work as a consequence of chalking. The practical importance of this result needs no emphasis. There can be little doubt that all other cultivations are facilitated by chalking. Seeing that the chalk

has already been applied 9 years and is still lightening the work to this extent it has obviously saved a considerable amount

TABLE II.—*Measurements for cross-ploughing Land already ploughed in Autumn. Cockshutt Plough, Austin Tractor.*

Average.	*Unchalked.*		*Chalked, 20 loads fine chalk.*		*Chalked, 50 loads "dug" chalk.*	
	Centre plot.	*S.E. plot.*	*Centre plot.*	*S.E. plot.*	*Centre plot.*	*S.E. plot.*
Miles per hour	2·14	2·21	2·50	2·27	2·27	1·88
Draught per plough, lb.	516	509	465	446	483	417
Per sq. in. in furrow section, lb. ...	7·37	7·12	6·63	6 37	6 90	5·95
Drawbar pull, lb. ..	1,548	1,527	1,395	1,337	1,450	1,250
Ransome Plough, Austin Tractor.						
Miles per hour ..	1 98		2·15		22·7	
Draught per plough, lb.	537		467		483	
Per sq. in. in furrow, section, lb. ...	7·67		6·67		6·90	
Drawbar pull, lb.	1,610		1,400		1,450	

Depth of ploughing, 7 inches.

Average of all results.

	Unchalked.	*Chalked.*
Miles per hour	2·11	2·22
Draught per plough, lb.	521	461
Per sq. in. in furrow section, lb.	7·39	6·57
Drawbar pull, lb.	1,562	1,380

in labour and will now save a great deal in the tractor. If it was desirable to apply chalk in the old horse days, it has become much more important to do so now, when every pound of drawbar pull has to be paid for and every fraction of a mile per hour additional speed means so much money saved. It is probably not too much to say that the liming or chalking of heavy land should be regarded as one of the essential factors in the use of the tractor. The difference becomes even more striking when a heavier tractor is used with the heavy plough, as would often happen in autumn ,and winter work. For comparison with the corresponding columns in Table II. the following figures are given.

Ransome Plough with Titan Tractor.

	Unchalked. Centre plot.	*20 loads chalk.* Centre plot.
Miles per hour	1·23	1·81
Draught per plough, lb.	608	475
Per sq. in. in furrow section. lb. ...	8·68	6·78
Drawbar pull, lb.	1,825	1,425

A part of this difference is due to the heavier weight of the Ransome plough, but the greater portion can be attributed to

the compacting of the soil in front of the plough by the Titan tractor, which weighs 60 cwt. against 30 cwt. for the Austin. In addition the Austin runs with two wheels in the furrow, whereas the Titan runs on the unploughed soil.

It would be interesting to know just why chalk or lime has the remarkable effect here described, and the inquiry is being made in the Soil Physics Laboratory at Rothamsted, because the action cannot properly be exploited until it is understood.

It is possible that the chalk affects the degree of moistness of the soil. There is a difference in the appearance of the land after rain, which suggests a difference in moisture content. In walking over the field in winter one notices a drier, more porous look on the chalked plots, and the land is less sticky; this is seen every winter, and is frequently demonstrated to visitors. This is no doubt an important factor in determining the improved growth of clover on chalked land, which then reacts on the subsequent crops.

It would not follow that the soil was actually drier because it looked so: the same results would be obtained if the soil were lightened or puffed up so that its pore space were increased.

It is not proposed, however, to discuss here the reasons for the effect of chalk: the important point is that chalk lightens the soil to the marked extent indicated by these measurements.

It is hoped to be able to extend these measurements and ascertain the effect of other manures on the work of cultivation. Farmyard manure is known to lighten the soil: green manure is assumed to have the same action. Sir A. D. Hall, when at Rothamsted, showed that the various artificial manures acted on soil each in a characteristic way, and it seems probable that these also may affect the work of the tractor. It is obvious that any action a fertiliser may have in increasing or diminishing the resistance of the soil to the tillage implements must be taken into account by the farmer in determining his choice of materials for use.

BRITISH GROWERS' SCHEME FOR GRADING AND PACKING APPLES.

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AND

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THE scheme for establishing in this country a proper system of grading and packing apples for the market, referred to in the article on "Grading and Packing" in the July issue of this *Journal*, has now been published by the Federation of British Growers. In this article an attempt has been made to explain this scheme, and a few notes have been added which, it is hoped, will be of assistance to those growers who may desire to adopt a system of grading and packing to meet the requirements of the scheme. In the past horticultural journalists have written much on this subject, and many meetings of the trade have been held to discuss measures of reform; this clearly indicates that the problem is not a new one. The minds of the traders and the general public, however, were not, a few years ago, susceptible to new ideas so drastic as to revolutionise the whole system of marketing, and little progress was made. Experience in marketing British apples during 1919, when a large quantity was wasted, combined with the large importations of well-packed foreign and colonial fruit during 1920, has caused horticulturists to view the matter from a different aspect. The retailer also, reflecting the preference of the consumer, has taken a definite stand, and by favouring in his purchases the well-graded and properly-packed imported fruit has clearly shown that he was by no means satisfied with the present system of marketing the home produce.

The Ministry has been urging all concerned to adopt improved methods of grading, packing and marketing, and with public opinion tending strongly towards action in the same direction, the Federation of British Growers has rightly seized a favourable opportunity for launching a practical scheme to deal with the problem. Those concerned in drawing up this scheme and in devising machinery for carrying it into operation deserve the support and goodwill of all British horticulturists, and of the public in general. If it is taken up enthusiastically by those interested in the growing and distri-

bution of applies, the scheme will probably revolutionise the system of packing fruit for the market and place it on a business footing. The Federation of British Growers is making history, and the movement will certainly be noted when the history of British fruit growing is written.

It is hoped that the articles on " Marketing of Fruit " and " Grading and Packing " in the June and July issues respectively of this *Journal*, made it clear that to ensure success it was necessary that any scheme should be an agreed one, approved and supported by all sections of the horticultural industry—the grower, the wholesaler and the retailer. The Federation of British Growers fully realised tnis important point. and having prepared a tentative scheme, convened a meeting on 24th May, the Controller of Horticulture being chairman, at which representatives of the Ministry, growers, wholesalers and retailers were present. The scheme of the Federation was, after consideration and amendment to meet the views of other sections, finally agreed to in the form set out below.

Before definitely setting out the scheme, it is probably wise to inform readers as to the course which the consideration of measures of reform has taken. A review of previous articles in this *Journal* would show that the Federation of British Growers proposed to issue labels to be used on packages containing apples properly graded and packed in accordance with the agreed conditions. Secondly, it was necessary to lay down standards for grades of fruit, quality, size of package, in terms of figures, so that the buyers and the sellers of the labelled packages would be able to discuss business matters in a language understood by all.

Spaces are left on the label for the grower to fill in the name of the variety, the grade of apple, and net weight or count of the package, and to add, if he desires to do so, his trade or other private mark. The label, duly completed by the grower, and used on the packages of standard size, purports to describe the apples accurately, and therefore becomes a form of contract between the seller (the grower or his agent) and the buyer of the fruit. It thus goes far to establish the system of " honest dealings," a point strongly emphasized by the Ministry in the provisional scheme.

The Federation of British Growers proposes to establish an Association known as the British Growers' Marketing Association, which will be responsible for the distribution of

the labels, and for the general organisation of the scheme. All growers of fruit, and associations of such growers, will be able to join this Marketing Association, and so reap all the advantages which are afforded by a scheme of this kind. Whilst an organisation of this kind cannot relieve the grower of financial responsibility for packages bearing the label, the contents of which fall below the stated standards, it must, as a necessary safeguard to the scheme, set up a Tribunal of Arbitration with power to give authoritative decisions in such cases.

The Scheme of the Federation of British Growers.—The particulars of the scheme as agreed to by the industry are as follows :—

1. **Apples.**—SPECIAL DESSERT fruit such as Cox's, &c.
   Quality—Perfect fruit only. Uniform colour and size.
   Grade—Min. diam. $2\frac{1}{4}$ in.
   Package—Peach box $17\frac{1}{2} \times 11\frac{3}{4} \times 4\frac{1}{2}$ in. inside.
   Count—

2. **Apples.**—DESSERT.
   Quality—Colour, even throughout package; sound, without any blemishes affecting keeping or quality; skin blemishes not to exceed 10 per cent. of the apples; evenly sized, min. diam. 2 in.
   Grades—(sizes) 2 to $2\frac{1}{2}$ in., Blue paper; $2\frac{1}{2}$ to 3 in., Pink and White paper; 3 in. and over, Pink paper.
   Packages—British standard box, $18 \times 11\frac{1}{4} \times 10\frac{1}{2}$ in. inside; Bonnet; Half-bushel sieve.

3. **Apples.**—COOKING.
   Quality—As in 2; Min. diam. $2\frac{1}{4}$ in.
   Grades—(sizes) $2\frac{1}{4}$ to $2\frac{3}{4}$ in., Blue paper; $2\frac{3}{4}$ to $3\frac{1}{4}$ in., Pink and White paper; $3\frac{1}{4}$ in. and over, Pink paper.
   Packages—Half-barrel; Barrel; Bushel-sieve; British standard box.

2 and 3. Every package to be well lined, with coloured paper showing at top. All wicker packages to be lined with stiff paper. Every apple packed in British standard boxes to be diagonally packed and separately wrapped.

Sale. (*a*) Boxes—count or net weight, or minimum net weight.
(*b*) Bonnet—Half-bushel and bushel sieves—tightly packed in layers.
Half-barrels and barrels—tightly packed.
Net weight or minimum net weight.

All these conditions only apply "*when packed.*"

Recommended standard sizes of empties (inside):—

Half-bushel—diam. 15 in.; depth at side 8 in.; depth in middle 7 in.
Bushel-sieve— „ 17 „ ; „ „ $10\frac{1}{2}$ „ ; „ „ 9 in.
Half-barrel—diam at top and bottom 15 in.; depth $16\frac{1}{2}$ in.
„ „ middle 17 in.

It will be noticed that the apples are classified into three groups: Special Dessert, Dessert and Cooking. To be

marketed under the heading Special Dessert, the apples must be perfect fruits, of uniform colour and size, the minimum diameter of which shall be 2¼ in. They are to be packed in peach boxes, and the number of apples is to be stated on the label. Many people will need convincing that perfect apples packed in shallow boxes will need any guarantee or label to sell them; from the method of packing the quality of the apples is apparent to the buyer, and no deception can be practised. Experience shows that growers now packing " Specials " in peach boxes have been quite satisfied with the results; and little complaint as to this class of fruit has been raised by the wholesaler or retailer. The action of the Federation of British Growers does, however, follow the practice which has been adopted in South Africa for oranges, where the First Grade is described in the Fruit Export Act as " Extra Specials." In this connection it is interesting to note that the Inspection and Sales Act of Canada, 1915, described the best grade as " Fancy Quality," but in the Amending Act of 1918 this quality was omitted, the inference being that no regulations were necessary for " Fancy Quality " fruit.

Reviewing the grades for dessert apples other than " Specials," it will be noticed that the apples have been graded according to size; the distinction between the grades or sizes is to be made apparent by the use of different coloured paper. This has distinct advantages, one being that theoretically the grades all start equal, and thus controversy as to whether a dessert apple of 2½ to 3 in. is superior or inferior to those of larger or smaller size cannot arise; secondly, traders have been accustomed to the use of coloured paper for differentiating the various grades of tomatoes—pink and white is used for the more expensive samples, pink for the medium price, and blue for the cheaper samples. This nomenclature for grades of apples appears to be unique. Most countries adopt a numerical system for classifying grades, such as 1, 2 and 3, though in some countries the word " Domestic " occurs. The scale of sizes 2—2½ in., 2½—3 in., and 3 in. and over would appear to apply well so far as British-grown dessert apples are concerned. It is probable that the middle size of fruit (2½—3 in.), being the normal size, will soon establish for itself the premier place on the markets in preference to the larger and smaller sizes; so that, like tomatoes, the grades of apples " Pink and

Whites," "Pinks," and "Blues" will in virtue of their respective merits adjust their positions in commerce. The scale of sizes must be subject to alteration, and possibly the standards of quality may be subject to modification; the selected packages now chosen may give place to newer and more adaptable ones; but the colours, once selected should, like the laws of the Medes and Persians, remain unalterable.

One can imagine that the Federation of British Growers and the Committee appointed to help them when discussing the matter, found very considerable difficulties in arriving at an agreement for standard packages. The British Standard Box would no doubt be recognised by most as the best package for dessert apples, but bonnets, in spite of their many disadvantages, by being non-returnable and of light weight, would be favoured by many; while the popular half-bushel sieve has served the British fruit grower too well in the past to be discarded lightly. Recognising these claims the Grading and Packing Committee of the Federation of British Growers acted wisely in deciding to include for the present all three packages. The measurement of the box and the half-bushel are stated so that standards for packages have at last been laid down.

For cooking apples a similar method of grading and classification is provided; but the scheme has not recognised cooking apples of a size less than $2\frac{1}{4}$ in. in diameter, a decision with which all growers may not agree. It should be realised that the label, to be of value, must be reserved to distinguish superior classes of apples, and most people would admit that generally the public does not regard a small apple for cooking purposes as ideal. The grades, the sizes, and the selected colours of papers will probably meet with general approval.

Four different types of packages are to be recognised, the half-barrel, the barrel, the bushel sieve, and the British standard box. Experience will soon decide the most suitable of these packages for each variety of apples. For most varieties and samples of cooking apples the box may be too costly to use, but it is no doubt included in order to provide a package for special cookers such as Newton Wonder, Gascoyne Scarlet, Blenheim Orange and Peasgood Nonsuch. Again, the respective sizes of these packages have been stated. The Ministry has been asked to bring to the notice of manufacturers the necessity for making only such packages as are of the prescribed measurements.

Quality.—It is very difficult indeed to define and describe on paper what is meant by quality, and little criticism on the standard adopted can be made as the Committee has adopted a perfectly safe course in fixing a high and uniform standard for all apples. The scheme reads: "Colour even through package: sound, without blemishes affecting keeping or quality; skin blemishes not to exceed 10 per cent. of the apples; evenly sized." In Canada, where a different standard of quality is fixed for each separate grade of apples, 1, 2, Domestic, and 3, not less than 90 per cent. of the fruit must be free from scab, bruise, wormholes and other defects in order to reach the standard of Grade 1; not less than 85 per cent. for Grade 2 and 80 per cent. for the Domestic Grade; and for Grade 3 the fruit must include no culls. After deciding to differentiate grades merely by sizes, each of which would be distinguished by a special coloured paper, and not by the usual classification of superiority, it was logical that the standard of quality should be the same for all grades. The Committee and the Federation of British Growers have, therefore, in establishing grades and quality, departed, and departed widely, from the usual custom; but by adopting a very high standard of quality greater limitations on the extended use of the label have been imposed, and it may be necessary for most growers to adopt better hygienic measures for controlling pests and diseases before they will be able to produce apples in any quantity 90 per cent. free from blemishes and skin spot. The value of the scheme in stimulating action in this direction will not be small. Again, the higher the standard of quality of fruit sold in labelled packages the greater appreciation will be given by buyers to such packages, which will raise the potential value of the label.

Packing.—All existing legislation on this subject in exporting countries requires that the apples shall be "properly packed." It is very difficult to define the expression further, though Canada states that "properly packed" means that the package should be well and properly filled.

The Committee and the Federation of British Growers have expressed their intention clearly by stating that every package must be well lined, presumably with paper, to protect the sides of the package from bruising the apples, and so arranged that coloured paper shows on the top. It is further recognised that the sides of wicker packages, being rougher, tend to bruise apples more readily, and packing with stiff paper is insisted

on in this instance—a wise ruling. In all cases the apples are to be tightly packed in layers. To those experienced in packing this rule appears unnecessary, for they recognise that apples cannot be packed otherwise than in layers, and that tight packing is essential if the pack is to remain firm during the journey. Large numbers of fruit growers are, however, not familiar with packing, so that the ruling is sensible and necessary. For boxes the Committee and the Federation of British Growers have accepted the diagonal pack which is admittedly the best pack for market fruit, and one that remains firm under rough handling; but it will be a surprise to many to read that every apple must be separately wrapped. It is recognised that wrapped apples are easier to pack than unwrapped ones, that the fruit is prevented from slipping about and so travels and keeps better because of its added protective covering. The public too is familiar with and expects to buy oranges, and even some imported apples, wrapped in tissue paper. Both in the standard of quality fixed, however, and also in this regulation as to wrapping, the Federation has boldly set itself to reach a high ideal by one jump. The Ministry could not withhold its approval, but it may be questioned whether to start with the realisation of the ideal is not something of a counsel of perfection, and whether as a practical policy it would not have been better to have made a beginning with provisions a little less rigorous and then, as growers became familiarised with the scheme, to have tightened it up. The high level to which costs have mounted creates a difficulty for all growers, and amounts to a veritable scare to many; even the cost of tissue paper wrappers may be the straw that weights the scales of judgment against the adoption of the scheme. The more up-to-date growers will, however, probably consider that the greater efficiency outweighs a slight extra cost.

It must never be forgotten that the scheme under review is primarily concerned with the home market. Regulations which may be absolutely necessary for an export trade can here be safely and wisely dispensed with. One does not, in saying this, lose sight of the nascent export trade in English apples which before the War was attaining quite respectable dimensions, and which it is of immense importance to encourage to the utmost. In the question of packages, as a contrast, the Federation scheme wisely deals with the well-known susceptibilities of the grower with almost maternal tenderness, and has lent the ægis of its protection to prolong the life of

several forms of package hoary with antiquity—forms which the ardent reformer, hasty for the attainment of the ideal, might have rejected.

Net Weight or Count.—The scheme to succeed has to meet the grievance of the retailer as to the honesty of the fruit, and especially so as regards the count or weight of apples in the package. For "Special Dessert" the number is more important than weight, and the count must be stated. For boxes of dessert or culinary apples either the count or net weight (or minimum net weight) gives the needed information, and according to the scheme the grower may decide which to declare. For half-bushels, bushels, barrels, half-barrels, and bonnets, &c., net weight, or rather the minimum net weight has to be declared. Few will take offence or object to this, for it is now generally realised that the buyer of fruit is entitled to know the weight that he is purchasing.

In conclusion, it should be stated that this voluntary scheme drawn up by the Federation of British Growers and approved of by the Committee representative of the horticultural industry, has adopted novel methods of classification of grading, and established a peculiarly high and fixed standard of quality for all grades of apples. The scheme is to be launched by the Federation of British Growers, and experience in working the scheme will indicate where modifications can be made. It has received the general support of the Ministry, and is earnestly commended to British fruit growers as the first step in the direction which the packing and marketing of all classes and kinds of vegetable produce, as well as fruit, must take (1) if the legitimate demands of a discriminating public are not to be met by imported produce only; (2) if the reasonable requirement of the retail distributor, that he shall be able to buy on something akin to the same basis on which he must sell, is to be met, and (3) finally, if British growers are not to be relegated into the wilderness of economic failure by the men who will organise upon business lines and adopt the new methods.

This scheme is purely voluntary, and will in no way interfere with, though it may exercise an influence upon, the marketing of produce of lower grades than those stated in the scheme.

COST OF HARVESTING POTATOES.

OFFICIAL Statistics for 1920 show that the acreage of potatoes in England and Wales was 544,615 with an estimated yield of 3,151,000 tons. Considering the importance of this crop it is a surprising fact that no figures have previously been published dealing with the cost of harvesting potatoes. This report gives an account of an attempt which has been made to obtain information on this subject.

Methods of Lifting.—Lifting is generally done by using the fork, the plough, or the potato digger. During the past year a few American potato lifters have been used.

Lifting by the *Fork* is undoubtedly the oldest method. In this way the work is well done, and practically all the potatoes are removed from the soil without bruising. The work is both slow and laborious, however, and hence where large acreages had to be lifted, the *Plough* soon displaced the fork and generally gave satisfaction. The wastage with the plough is undoubtedly more than when the fork is used, but it is generally believed that the crop is harvested with a considerable saving of labour and expense. This practice is still followed for lifting potatoes grown in the heavier classes of soil. and even for first early varieties grown in light soils.

In more modern times engineers turned their attention to machinery for agricultural purposes, and produced a mechanical *Potato Digger* which lifts the crop much quicker than had hitherto been possible with either the fork or the plough. In the early days, when the digger was in its experimental stage, it bruised the tubers considerably, and even with the present-day machines a certain amount of damage is done. Some bruising seems inevitable, as considerable force has to be exerted in throwing both tubers and earth well up into the air. Further wastage from loss of tubers occurs since the earth on falling to the ground covers many of the tubers, and it is probable that a considerable number remain buried in the soil and are not turned up by the harrows. In spite of these drawbacks, the digger has gained favour, and is now largely used in the extensive potato areas.

Scope of Enquiry.—The Ministry was anxious to obtain, if possible, figures showing the comparative and approximate costs of harvesting potato crops by the three methods, and accordingly

invited farmers to fill up a Questionnaire giving particulars of the soil, crop, acreage, method of lifting, and the man and horse power employed. Inspectors of the Horticultural Division co-operated with farmers in obtaining these figures. As a result the Ministry received reports of the cost of harvesting 703 acres of potatoes on 50 separate holdings; the information in 15 cases relating to 104 acres was not of sufficient value for the purpose, and was disregarded.

Bearing in mind the fact that a small holder might not be in the position to use the same method of lifting as that employed by a large potato farmer, an attempt was made, (1) to find out what constituted a "working unit" for each system, *e.g.*, the number of horses and amount of labour to keep one plough or one digger at work; (2) to determine the cost of keeping one of these units at work for one day; and (3) to ascertain the quantity of potatoes lifted by each unit per day.

It was expected that the cost of lifting the potatoes would vary with the different classes of soil, seeing that both the size of the crop and ease of working the soil would be largely influenced by its texture. The figures for each class of soil were tabulated under three headings, *Heavy Soils*, *Medium Soils*, and *Light Soils*. From these figures it was seen that a working unit could raise in a day a larger quantity of potatoes on medium soils than on heavy soils, whilst on light sands the tonnage raised per day was slightly less than on medium loams. The latter is probably due to the fact that the medium soils yield heavier crops than do sands.

Lifting by the Fork.—From the information received, it was impossible to draw any conclusions as to what constituted a "working unit" in the case of the fork. For instance, one farmer employed 7 labourers with forks to 3 women gatherers; another farmer, 2 labourers with forks to 2 boys; and a third 12 labourers with forks to 12 gatherers. Neither did the figures obtained give any definite information of the acreage lifted per day by one man with fork.

Lifting by the Plough.—Similarly, the figures obtained where the plough was used were on the whole so unsatisfactory that no safe conclusions could be drawn. In one case, however, the return received showed that the farmer had been to some pains to prepare a clear and accurate statement, and the results are interesting as showing that with a good crop and efficient organisation the cost of harvesting can be kept low.

The "working unit" was constituted as follows:—

Ploughing	...	1 man, 2 horses.
Harrowing	...	1 „ 2 „
Carting ...	...	2 men, 2 „
Pickers ...	...	10 women behind the plough and 2 women clearing behind the harrows.
At Clamp	...	2 men.

The soil was of the medium loam type and the crop lifted was approximately 10 tons per acre. This unit was able to clear 2 acres (*i.e.*, 20 tons) per day. The actual cost per day of keeping the unit at work was as follows:—

	£	s.	d.
1 man with 2 horses for Plough	1	10	0
2 men with 2 horses for Carts	2	0	0
1 man with 2 horses for Harrows...	1	10	0
12 women (pickers) at 8d. per hour	3	4	0
2 men at Clamp at 8s. 1d. per day	0	16	2
	£9	0	2

From these figures it will be seen that the cost of harvesting the crop was only 9s. per ton. It should be borne in mind, however, that the figures relate to a particular case, in which the working costs are probably less than the average and the weight of the crop considerably above the average. The charge for horse labour alone is considerably lower than that obtained (13s. 6d. per day) by taking the average of all the returns.

Lifting by the Digger.—1. *The Composition of a "Working Unit."*—From the returns received it appears that an average "working unit" required to keep a potato digger at work, and to pit the potatoes as lifted, is 1 digger, 1 pair of harrows, 3 carts, 6 horses, 1 foreman, 4 horsemen, and 21 labourers and gatherers. As might be expected the number of labourers and gatherers required is greater in the case of the lighter and medium classes of land and less for the heavier classes of land.

2. *Results.*—On the lighter classes of land, such as the sands and the light loams, about 2.8 acres could be cleared by one unit in a day, whilst on the heavy loams and the clays, where the digger meets greater resistance from the soil, and transport problems are more difficult, the acreage cleared by the same unit was no more than a little over 1.8 acres, or 1 acre a day less than on light soils. When it is remembered that the larger crops of potatoes are also produced on the medium classes of land such as light loams, the full importance of this will be appreciated. From the lighter soils a "working unit" on the

average raised and pitted 25 tons 12 cwt. per day—though in one instance the figures were as high as 36 tons 13 cwt., probably the result of superior organisation on the farm. The highest quantity lifted and pitted from the heavy soils by a "working unit" was 15 tons, whilst the average was as low as 13 tons 17 cwt. The weight of the crop per acre is also not without influence on the quantity lifted per day, as will be seen from the following Table, which relates entirely to crops produced from the various classes of light and medium soils.

	Crop per acre.			*Tonnage lifted per day by unit.*	
	Tons.	Cwt.		T ns.	Cwt.
Holding No. 1	11	—	.. ...	36	13
„ 2	10	—	......	30	—
„ „ 3	10	—	......	27	10
„ „ 4	9	—	......	27	—
„ „ 5	7	—	......	18	8
„ „ 6	6	—	......	12	—
„ „ 7	3	2	......	7	—

3. *Costs.*—The figures have been deliberately presented so far without any reference to cost. In these changing times, any prices mentioned only remain of value for a limited period, and often are out of date before being published. So far as labour for potato raising is concerned, the wages have been fixed by the Wages Boards for the respective districts, and naturally vary for each district and for each class of labour.

All horse labour is charged on the assumption that the grower had to hire the necessary horses at the current rate of the district, which on the average appears to be 13s. 6d. per day. The average wage for a foreman is 12s. 6d. per day; for skilled labourers, such as horsemen, &c., 9s. 9d. per day, for labourers 9s. per day, and for women 5s. per day.

The daily cost of maintaining a "working unit" with a digger on harvesting potatoes, as determined from the returns sent in, and at the prices stated, would therefore appear to be £12 13s. 6d. This means that the average cost of harvesting a ton of potatoes grown on the lighter and heavier classes of soil would appear to be 9s. 11d. and 18s. 4d. respectively.

The figures bring out in a striking manner the financial disadvantage of the grower of potatoes on heavy solis: (1) His cost of preparatory cultivation is greater and the comparative cost of raising his crop is higher, than that of his fellow farmers on the light loams; and (2) the crop from the heavy lands will be appreciably smaller than from the light loams.

These factors operate in the same direction so far as the potato farmer on heavy soils is concerned.

In each case, the cost of the disposal of the crop, either by clamping, or bagging and conveying to the nearest railway station, or dispatch to the nearest railway station for conveyance in bulk (*i.e.*, unbagged), was taken into consideration in obtaining the cost of harvesting the crop.

Value of Spraying.—The Questionnaire asked growers to state whether the crop had been sprayed or not. In 13 cases the crops were reported to have been sprayed, whereas in 27 cases no spray had been used. The average crop on the sprayed area was approximately 10 tons per acre; while that on the unsprayed area was a little over 8 tons per acre. The heaviest crop on a sprayed area was 15 tons per acre in Bedfordshire. The area was slightly over 18 acres, the varieties being Great Scott, Ally, Lochar.

The next heaviest sprayed crop was 14 tons per acre over an area of 22 acres in Surrey. The varieties were Arran Chief, Ally and Majestic, the first variety occupying two-thirds of the area. The heaviest unsprayed crop was 12 tons per acre over an area of 17 acres in Surrey, the varieties grown being Arran Chief and Ally in about equal proportions.

It is recognised that growers who spray their potatoes may also give more attention to cultivation than do other growers, but this fact does not lessen the value of spraying as a means of securing a larger tonnage per acre.

WOMEN IN RURAL LIFE.

GRACE E. HADOW.

AMONG the many unexpected results of the War has been a dawning realisation of the part which must be played by women in rural life if our country-side is not to become depopulated. The Land Army did splendid service in helping to keep farms cultivated when otherwise they must have lapsed. Women ploughed, thatched, drove horses and tractors, and, as women have always done, weeded and hoed. Undoubtedly the result was to make many women realise ways in which they may become agricultural workers in peace as well as in war; to stimulate their desire for an open-air life; and to give farmers confidence in women, especially for dairy work and market gardening. A certain number of women have taken, and will continue to take up these occupations as a direct consequence of the call to service on the land.

The influence of the Land Army, however, was far wider, and in a sense far more important than this. It taught country women of all classes to take an intelligent interest not only in agriculture and horticulture, poultry keeping and pig keeping, but in rural life generally. The extraordinary growth of the Women's Institute movement is perhaps the most conspicuous and striking evidence of the new life stirring in the country-side, but it is only an evidence of something still more wide spread. During the War educated women lived in cottage homes and worked side by side with agricultural labourers. Town dwellers came from crowded alleys to make hay and stook wheat; country girls who had never left home before, went away to work in huge munition factories. In the great kaleidoscope of war we were shaken together—we are still being shaken—and in forming new patterns we gained new adaptability.

Two forces in this freshly-shaping world are at present in danger of pulling opposite ways. The improved status of the woman labourer, the intelligent interest which has been developed in food production and in house-craft, pull one way; the increased consciousness of the dullness of country life pulls the other. No sane being wants to see all farms "womaned" instead of "manned," or even the majority of country-women become agricultural labourers. Quite apart from their actual work in dairy or poultry-yard or garden,

however, women have a vital part to play in rural development. The elimination of this tug-of-war is important. The War encouraged us to use our reason. No person who does so is going to submit to the conditions which have hitherto prevailed in many villages. A picturesque cottage with no water laid on may give pleasure to the tourist, but it has disadvantages from the housewife's point of view. A life of—largely unnecessarily—hard work, enlightened only by an annual village concert, is not one which ought to hold men or women. The natural shrewdness of the peasant is beginning to ask why it should. In one village it was said that twenty-eight men returned from the Army to work on the land as they had done before. At the end of a month, twenty of them expressed their intention of leaving and going into the town because neither they nor their wives could stand the monotony of country life. The same plaint rises from all sides.

If our rural problem is to be solved, there is one way and one way only in which to meet it, and that is to allow countrymen and women to develop rural life on lines hitherto little explored. Probably there has never been so good an opportunity for farmers to get intelligent workers, because there has never been so wide-spread a desire for education and for the stimulus of recreation. Most of us have met the Rev. Abraham Plymly, who through living long in the country "had become as it were a kind of holy vegetable." Let him be contrasted with the group of ploughboys of 15 and 16 who recently came to ask for help because they were forgetting what they had learned at school, or the class of elderly working women in a tiny village who asked for—and attended —a six weeks' course on Mediæval History. Not long ago the writer asked the members of a Women's Institute on what subject they wished to have a speaker at their next meeting. The answer came prompt and unmistakable, "The connection between Wages and Prices, please." Most interesting and most hopeful of all, these women are beginning to want information on which to form their own opinions. They want people to give them facts, and then to discuss them themselves.

The intelligence developing on these lines is making itself felt, as it inevitably must, in other directions also. The matter of rural industries is by no means a simple one, but without going into vexed questions of competition, local trade, and home industries generally, it may fairly be said that a large and rapidly increasing number of village women are learning

to make certain articles for home use and for sale to a small extent, and in doing so are at once adding a great and growing interest to village life and learning the elements of co-operation. The "Members' Stall" which is a feature of many a Women's Institute Meeting has often a tiny turnover reckoned in money, but the stimulus that it gives to craftsmanship and to interest in learning new methods reacts on the whole village. In certain market towns village women have now their own market stall, to which they bring such odds and ends of produce as they may have each week. It would not be enough to supply a shop. It is uncertain in amount and irregular in character. One such stall, however, had a turnover of £800 last year. Not only does this give the women an interest in production, on however small a scale, but it teaches them to co-operate in buying seed or chicken food or what not, and in marketing. It also leads women and men to a greatly increased interest in county council lectures on food production and preservation.

Country life is far from dull in itself; it becomes dull when it is allowed to become lonely and monotonous. The Postmaster-General spoke a short time ago of his dream of having the telephone in every village. At the moment opinion might differ as to the added gaiety and content likely to result from the installation of a telephone in every home, but the principle is sound. Many facilities for social and educational life, many appliances for lessening labour, which we consider essentially urban, are to be found in the far more scattered and remote villages of Canada and the United States. When English country-women really face the problem, not how to endure but how to enjoy country life, a larger number of agricultural difficulties will be diminished, if not removed, than farmers possibly realise, for in the long run the women have considerable control over the situation in their power to make home life comfortable or uncomfortable, and in their influence on husband and children. In many districts before the War, work on the land, the true aristocrat of industry, had fallen into disrepute. It was considered a rise in the social scale to wear the black coat and pasty face of a sedentary worker, and agriculture was in danger of becoming like one of those stately old homes which the tide of fashion has left slowly decaying in what is now a back street. The War has done much to bring back a more sane and healthy point of view, but it depends largely on country-women if that standpoint is to be maintained.

BESOM-MAKING IN DERBYSHIRE AND NOTTINGHAMSHIRE.

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SMALL rural industries are often hereditary in their nature. Providing little more than a bare subsistence in return for long hours and exacting work, they do not attract youth from elsewhere. Boys learn from their fathers because they are surrounded by the tools and the jargon of the trade from their infancy upwards, and because the father presses the boy into it as soon as possible: even a child's help in handing tools, preparing material and other small matters will lighten a man's work. The trade connections, both for the supply of raw materials and the distribution of goods to the customer, make an easy niche into which the boy can slip, and unless he feels active dislike of the work and has an enterprising nature into the bargain, he is likely to settle down to his father's trade. Many young people continue a hereditary industry for negative reasons of this sort, but there are some who carry it on in a positive way. Love of the work and aptitude for it are bred in the bone, and pride of family and craft mingle to give working life an interest and a meaning that can only be obtained for most people through the pursuits of their leisure time. An eight-hour day is only necessary for the man whose work is uncongenial, and who must have leisure in which to follow out that part of his life in which he can truly live. Men who work from 5 a.m. to 10 p.m. are not entirely legendary, but are always to be found among those whose work satisfies every side of their nature. Men carrying on hereditary crafts may possibly be included among these.

Forest products provide much material for small rural industries, and writers on social conditions have often noted the variety of occupation and comparative prosperity of even the poorest villagers who live within reach of woods. A modern example of a small but flourishing industry that depends on woods or forests on the one hand and heather moors on the other is that of besom-making.

Materials.—Many besom-makers are found around Chesterfield and at isolated places on or near moors—Dore, Darley Dale and Bamford in Derbyshire, and near Mansfield and Ollerton.

A besom-maker usually goes with his horse and cart and cuts the heather under the direction of the gamekeeper, to whom it is an advantage to have the heather kept down by this means. If it were not cut, it would have to be burned—a more laborious and less satisfactory method for the keeper. On some estates a nominal sum is paid for the privilege of cutting, on others a tip to the keeper is in vogue, while on a few there is no money transaction. The heather must usually be cut before Lady Day, but as there appears to be little deterioration in it when stacked if it is cut in dry weather, this is not a disadvantage to the besom-maker.

The other most important material used is wood for the stakes (or handles). If the besom-maker lives in a wooded district, as well as near the moors, so much to his advantage, and it is usual for the two supplies to occur together, as extensive moors are part of large estates on which there are almost invariably some plantations and therefore underwood for sale.

Another material for making besoms is birch twigs. These can usually be obtained near the stakes, from the underwood cut on the estates. In Derbyshire and Nottinghamshire, however, a far more important outlet is to be found for heather besoms. These are used in the steel works of Sheffield and in malt kilns, whereas birch besoms are mainly used for lawns and gardens.

Old-fashioned besom-makers used split ash for binding the heather or birch, and one or two men who make besoms as a part-time occupation have never troubled to learn modern methods and still use it. It is very laborious: only half-a-dozen strands can be cut off each stick and then the centre is used as a thatch pin. Cane is used for this purpose by all whole-time besom-makers: one man said that he was able, in one hour with cane, to supply his son with all that he would require for a day's work; with split ash it would have taken four hours.

Implements.—Besom-making is almost entirely a hand-industry. With the exception of a tool known as a "needle," for threading the cane through the brush, the only implement used is a very simple iron press or vice worked with the foot which presses the heather into place while the cane is being wound around it. It is a comparatively modern invention and was unknown to the fathers of present besom-makers. One man was heard of who had begun to use it only last year, but he was one of the part-time workers of the forest district of Nottinghamshire. These men usually make besoms of

birch because they are out of reach of the moors; they make them for a few old regular customers and only keep on the trade because it has come to them from the previous generation and they have got the habit of it, while for their main livelihood they rely on something else. The only man to use split ash was one of the part-time workers. The old method of pressing the brush into shape was done by gripping the ash or cane in an instrument known as a "stool" or "saddle," which stood on the floor, and pulling. The strain then came on the binding and often broke it before it was put in place. With the iron foot-press the strain comes on the heather where every ounce of it is an advantage. The press is so simple that after a brief description of it any village blacksmith can make it.

Quantities.—The time it takes to cut and fetch heather, and the quantity in a load, differ. From Mansfield it was said to take three days to cut and bring in a load. Six armfuls of heather was called a bundle and there were forty bundles in a load; one bundle made a dozen besoms and one old man and his son used five bundles in a day.

From Chesterfield one load of heather took only one day to cut and fetch. There were 160 bundles of heather in a load, but each bundle only made seven besoms at the outside, and sometimes only five or six. Distance from the workshop to the moor would make the difference in the time it took to cut and bring in, but there must also have been a difference in the size of the bundles.

Prices.—The usual price for the completed besoms seems to be 6s. 6d. or 7s. a dozen. It is difficult to estimate the cost of heather; one man considered that carting it cost him 8s. to 10s. a load, but when the price of a carter with his horse and cart is usually reckoned in the same neighbourhood to be about £1 a day this would seem to be under-estimated unless there is some special arrangement. Besom-makers who employ more than one or two men find it convenient to keep a horse and cart of their own, and for those who are part-time besom-makers the occupation into which it best fits is found to be carting.

Beson stakes cost 4s. to 5s. a hundred, where before the War they were 1s. 6d. a hundred. In some districts, especially near Chesterfield where there are several besom-makers and few trees, they may have to be sent from some distance. When this occurs the price may be doubled by railway carriage, and stakes will cost, perhaps, 8s. a hundred.

Cane sometimes costs 10s. a cwt. and freight another 5s. a cwt.

A man who does not own a horse and cart has another expense. To send besoms to the station ready to be shipped away may cost 2s. 6d. a load; before the War the railway collected them free.

Markets.—Sheffield seems to provide an unlimited market for besoms. They are used to sweep up steel-shavings in many works, and as some of the floors are hot and burn away the besoms quickly, they are required in large quantities. One man who has a larger establishment for making besoms than most others, sends fifty dozen a week to Sheffield. Others supply railway companies, coal mines, and malt kilns at Derby, Newark and many other places. For malt kilns, besoms made of ling rather than heather are preferred; for lawns they are always made of birch.

Some years ago when many battleships were being built and large quantities of steel plates were being made in Sheffield, another use for birch twigs was discovered. Red-hot steel plates develop a kind of flake or shale when they first come in contact with the air; the burning of birch twigs strewn lightly on them removes the flake. One besom-maker who supplies the steel trade in Sheffield used to send bundles of birch twigs to be used for this purpose. Other twigs can be used but birch are the best. This trade is now at a standstill.

Besoms and Baskets.—One or two besom-makers combine with their business that of making a sort of rough oak basket known as a skipp or skepp. The oak is soaked in hot water and then split into wide thin strips: these are then woven round a framework of strong osier or thin hazel. The basket when finished is not tight enough for coal but is used for coke, and in some of the Sheffield works it feeds furnaces where basket as well as coke must be consigned to the flames. It is particularly useful for such a purpose because all the material of which it is made will burn.

The oak is usually of that quality which, in the winter of 1920-21, was sold for 3s. 6d. a foot. This is not the best quality, but any size will do for the besom-maker as long as it is "kind." It must be straight and without knots. About sixteen dozen of these baskets go to Sheffield each week and the price is 30s. a dozen. One man can make ten baskets in a day (from 7 a.m. to 5 p.m.), but if his oak is split and all materials ready he can make sixteen to eighteen baskets a day.

EXPERIMENTS ON THE CONTROL OF ONION SMUT.

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THE attention of growers in this country was first drawn to the new and serious disease of Onions and Leeks, called Smut, by A. D. Cotton in this *Journal* in 1919.* The disease which is due to the fungus *Urocystis cepulæ*, and fortunately appears to be localised in a few centres; and there is no evidence that it is spreading rapidly, if at all. It should be remembered, however, that Onion Smut is a seedling disease, and is very easily overlooked at that stage in the growth of the plant when it is most destructive, *i.e.*, when it is in the two-leaf condition. It is possible, therefore, that the disease is more widely distributed than is at present suspected.

The serious result that would follow any increased distribution of the disease is evident from the fact that in Northumberland, where the most severe attacks have been experienced, a loss of 90 per cent. of the crop may be expected if the growing season is unfavourable.

As early as 1884, Worthington G. Smith† expressed the fear that Onion Smut was already present in this country. He was led to this conclusion by the many complaints that onions were falling into a black, dusty mass after harvesting. It is not possible to say whether the disease did exist at that time in this country, but the fear expressed, at any rate upon the evidence given, was unfounded, for it is now known that Onion Smut does not produce the symptoms described. There can be little doubt, however, that the disease existed in this country many years before it was first identified, in 1914, by W. B. Mercer, then Adviser in Agricultural Botany at Armstrong College, Newcastle-on-Tyne.

The Northumberland Outbreak.—The early history of the two infected centres in Northumberland has been investigated by the writer. The disease was apparently first noticed in or about the year 1900. In one case it appeared the first season after purchasing seed from the south of England. Before this seed had always been purchased from a small grower in Edinburgh, and in view of the discovery in 1912 that smut was present in the neighbourhood of that city, it is an interesting conjecture

* A. D. Cotton, Onion Smut:—A disease new to Britain, this *Journal*, Vol. xxvi., No. 2, 1919.
† Worthington G. Smith, *Diseases of Field and Garden Crops*, 1884.

whether the disease at Crookham-on-Tweed was introduced by the use of contaminated Scottish seed. At one centre (Wylam) the grower is of the opinion that the Smut followed the purchase of an unusually large quantity of seed consequent upon the decision to increase the acreage under onions; but he is unable to recollect the locality from which the seed was purchased. It appears to be definitely established that Onion Smut can be carried by means of contaminated seed.*

So far as the writer is aware the total acreage infected in Northumberland is as follows:—Crookham-on-Tweed, ¼ acre; Wylam-on-Tyne, 7 acres, and one 3-acre field on the eastern boundary of the village; Horsley, one 3-acre field and three separate plots of ½ acre each. A further small plot at Whitley Bay is possibly infected since it is known that seedling onions grown in infected soil have been planted there.

All the plots except the first and last are cultivated by the same grower, and in all probability the disease has been carried from one field to another on the boots or implements of the workmen. Examination of neighbouring gardens failed to reveal any signs of Smut.

The system of cultivation on all the infected plots follows the usual lines except that most of the crop is left unthinned. The only manure used is either farmyard or stable manure, and the seed is drilled in rows about 12 in. apart. At Wylam, the main sowing is done in August, the crop being sold the following spring as "scallions" for the table. The practice at Crookham, however, is to sow in spring, usually for sale as transplants.

The actual date of sowing has little effect upon the intensity of attack, this being very largely determined by the kind of growing weather experienced. Autumn-sown crops usually suffer much more severely than do spring-sown, and a dry growing season undoubtedly results in a greater loss from smut than is to be expected if the season is warm and moderately damp.

Experiments on Controlling the Disease.—The first attempt to control the disease was made by W. B. Mercer, in 1915, at Wylam, on a plot of land which had carried gooseberry bushes for 16 years and had never been under onions within the memory of the grower.†

* G. H. Chapman, Mass., Sta. Rpt., 1909, pt. 1, pp. 164-167.

† The question as to how this plot became infected can now be merely a subject for speculation. Since the plot is centrally placed in a garden which is badly infected, there is little doubt that both wind-borne spores and spores carried on the boots and implements of the gardeners have contributed to the dissemination of the disease. The possibility, however, of surface drainage water playing its part in distributing the spores should not be overlooked.

After being harrowed flat the land was treated as follows :—

Plot A (64 sq. yd.) received a mixture of 12 lb. of sulphur and 24 lb. of builder's lime; the latter, however, when received, appeared to be completely slaked. Immediately after application the mixture was harrowed in.

Plot B (28 sq. yd.) received 10 lb. of calcium cyanamide worked in as in Plot A.

Plot C (18 sq. yd.) was treated with a solution of formaldehyde (1 lb. of commercial formalin dissolved in 3 gal. of water). The solution was applied by means of a watering can.

In all three cases the seed was sown a fortnight after the land had been treated. The main crop of onions on an adjoining plot acted as a control.

A considerable amount of disease appeared on all the plots. None of the treatments seemed to have effected any diminution in the intensity of attack. The one interesting fact brought out was the value of thorough surface cultivation. A strip of land, including about four rows along the edge of all the plots, was left unhoed and it was noticed that this strip suffered far more from Smut than did the remainder. This fact has been repeatedly observed in subsequent experiments.

Unfortunately, the trials had to be abandoned, and were only resumed when Mr. Mercer and the writer returned from war service in 1919.*

A further set of trials was devised in 1919. These trials were based upon three suppositions :—

(1) That a trial of varieties might reveal differences in susceptibility to attack, which might be turned to account. In the United States, for instance, it has been stated that tender white varieties are more susceptible than are yellow ones.†

(2) That some means must be discovered of increasing the rate of germination of the seed, since once the seedling is above ground it is not susceptible to attack.‡ It was found in the course of laboratory experiments that a weak solution of sulphuric acid greatly increased the energy of germination of onion seed, possibly by hydrolysing the starchy endosperm or by rendering the seed-coat more permeable to watery salts.

(3) That the failure of the formalin treatment in 1915 might be due to the volatile nature of that compound. An attempt was therefore made to increase the length of time during which the gas would act by applying solid paraform instead of liquid formalin.

* The first 1919 trial was devised conjointly, but as Mr. Mercer left the locality shortly after the seed was drilled, the responsibility for observations and conclusions rests with the present writer.

† B. D. Halstead, New Jersey Sta. Rpt., 1898.

‡ T. Whitehead, *On the Life History and Morphology of Urocystis cepulæ*, Trans. Brit. Myc. Soc., Vol. vii, pt. I, 1921, pp. 65—70.

Seed Treatments, 1919.—The following treatments were carried out. The very susceptible variety "White Lisbon" was used throughout, and the seed was drilled on May 1st.

Plot 1 (Rows 1 to 4). Soot and salt applied to land on May 1st, and thoroughly worked in.

Plot 2 (Rows 5 to 8). Untreated control.

Plot 3 (Rows 9 to 12). Row 9. Soil untreated, seed soaked for two days in 0·1 per cent. sulphuric acid, washed and dried.

Row 10. As in row 9 but 0·5 per cent. acid used.
Row 11. As in row 9 but 1 per cent. acid used.
Row 12. As in row 9 but 2·5 per cent. acid used.

Plot 4 (Rows 13 to 20). Row 13. Seed treated with 0·2 per cent. acid as in row 9 and afterwards shaken up with 0·07 grammes of paraform, just before sowing.

Row 14. 0·5 per cent, acid treatment and 0·28 grms. of paraform.
Row 15. 0·5 per cent. acid treatment and 0·56 grms. of paraform.
Row 16. 0·5 per cent. acid treatment and 1·4 grms. of paraform.
Row 17. No acid treatment but treated with 1·4 grms of paraform.
Row 18. No acid treatment but treated with 0·56 grms. of paraform.
Row 19. No acid treatment but treated with 0·28 grms. of paraform.
Row 20. No acid treatment but treated with 0·07 grms. of paraform.

The seed for Plot 4, *i.e.*, rows 13 to 20 inclusive was, in each case, shaken up with the proper quantity of paraform immediately before sowing. It was found, however, that the seed hopper became dusted inside with paraform, so that the last four rows probably received a heavier dressing than was intended.

NOTE.—A small plot (8 sq. yd.) along the edge of Plots 1 to 3 inclusive had about ¼ lb. of paraform worked in on Feb. 21st. This plot produced but a scanty crop and many of the plants were diseased.

In addition to the White Lisbon seed used throughout Plots 1 to 4, seven other varieties were tested.

Taking a full crop as 33 plants, a count gave the percentage of healthy plants in one foot of each row as follows:—

Row (1) 54·5; row (2) 21·2; row (3) 60·6; row (4) 12·1; row (5) 9; row (6) 12·1; row (7) 6; row (8) 15·1; row (9) 3; row (10) 3; row (11) 6; row (12) 0; row (13) 3; row (14) 3; row (15) 0; row (16) 3; row (17) 12·1; row (18) 6; row (19) 6; row (20) 12·1.

All the varieties tested proved to be susceptible; the best one (Red Garganus) giving only 36 per cent. of healthy plants.

Soil Treatments, 1919.—In the autumn nine plots, each one yard wide, and extending across the whole trial ground, were treated as follows:—

Plot (1) ½ lb. of paraform worked into the land on Aug. 25th.
Plot (2) 2 lb. of bleaching powder applied as in plot (1).
Plot (3) 2 lb of soot worked in on Sept. 1st.

Plot (4) 2 lb. of salt worked in on Sept. 1st.

Plot (5) 2 lb. each of soot and salt worked in on Sept. 1st.

Plot (6) Untreated control.

Plot (7) 2 lb. of lime worked in on Sept. 1st.

Plot (8) 1 lb. of Nitrate of Soda worked in on Sept. 1st, followed by a similar top-dressing after sowing (Sept. 3rd).

Plot (9) Top 3 in. of soil removed, burned and replaced.

Across these plots, seed, treated as under, was drilled on Sept. 2nd in rows 12 in. apart by means of a Planet Junior single row drill:—

Series (1) 8 rows drilled with 2 oz. of seed mixed with 14 lb. sand.

Series (2) 4 rows untreated seed as control.

Series (3) 4 rows (2 oz.) seed soaked in water two days and dried.

Series (4) 2 rows (1 oz.) seed soaked in 0·5 per cent. sulphuric acid for two days and dried.

Series (5) 2 rows seed soaked in 0·5 per cent. acid, dried and dusted with 0·07 grms. paraform just before sowing.

Series (6) 4 rows seed soaked in 1 per cent. acid for two days and dried.

Series (7) 4 rows treated as in (6) but using 5 per cent. acid.

Series (8) 2 rows treated as in (6) but using 10 per cent. acid.

Series (9) 2 rows treated as in (6) but using 10 per cent. acid for 1 hour.

Series (10) 4 rows seed shaken up with 0·14 grms. of paraform.

Series (11) as in (10) but using 0·28 grms. of paraform.

Series (12) as in (10) but using 0·56 grms. of paraform.

This trial gave 108 different combinations of seed and soil treatments; the part where Series (2) crossed Plot (6) acting as control. Counts were made of the number of healthy plants in the middle foot of each row of seed along the untreated plot; this gave the effect of seed treatment. Another count was made of the number of healthy plants in the middle foot of each plot along the untreated seed rows; this gave the effect of soil treatment.

Effect of Seed Treatment.	*Effect of Soil Treatment.*
Series (1) average = 13	Plot (1) average = 9·5
Series (2) average = 10 (control)	Plot (2) average = 14·75
Series (3) average = 25·25	Plot (3) average = 14·5
Series (4) average = 12.5	Plot (4) average = 15·25
Series (5) average = 18·5	Plot (5) average = 11
Series (6) average = 12	Plot (6) average = 10 (control)
Series (7) average = 14·5	Plot (7) average = 22·5
Series (8) average = 4·5	Plot (8) average = 1·5
Series (9) average = 26	Plot (9) average = 3
Series (10) average = 16·5	
Series (11) average = 21	
Series (12) average = 14·25	

The best seed treatments, therefore, were :—soaking in water for two days; soaking in 10 per cent. sulphuric acid for one hour; and dusting with 0.28 grammes of paraform.

The best soil treatments were :—lime, salt, bleaching powder and soot.

The sowings were made so late (Sept. 2nd) that it is certain that these figures include plants killed out by the cold weather as well as those killed by Smut, but that they roughly represent the mortality due to Smut is shown by the fact that adjoining plots which were sown earlier had 90 per cent. of the crop diseased.

Probability of Death Resulting from Infection.—To test whether infected plants are able to " grow out " of the disease, 45 plants affected with Smut were marked and kept under observation. The fact that 42 of these plants succumbed shows that the chances of an infected plant surviving are somewhat remote.

Soil Treatment, 1920.—On May, 6th, 1920, a trial, was laid down similar to the autumn trial of 1919, with the addition of a plot treated with 2 lb. of carbon bi-sulphide worked into the land a fortnight before sowing.

In each case an area of 7 yd. by 1 yd. constituted a plot.

Counts were only made along the untreated seeds rows with a view of determining the effect of the soil treatments.

Taking 100 as representing a full crop for one yard :—

Plot (1) ½ lb. of paraform worked into the land a fortnight before sowing gave 60 healthy plants.

Plot (2) 2 lb. of bleaching powder applied as in plot (1) gave 0 healthy plants.

Plot (3) 2 lb. of salt applied as in plot (1) gave 10 healthy plants.

Plot (4) 2 lb. of soot applied as in plot (1) gave 30 healthy plants.

Plot (5) 2 lb. each of soot and salt applied as in plot (1) gave 2 healthy plants.

Plot (6) Untreated Soil gave 15 healthy plants (control).

Plot (7) 2 lb. of lime applied as in plot (1) gave 15 healthy plants.

Plot (8) 1 lb. of nitrate of soda worked into the land a few days before sowing, followed by a similiar application a few days after sowing, gave 10 healthy plants.

Plot (9) Top 3 in. of soil removed, burned and replaced, gave 70 healthy plants.

Plot (10) 2 lb. of carbon bi-sulphide applied as in plot (1) gave 50 healthy plants.

From these results it would appear that the best soil treatment was burning; the next best was paraform; and the third best carbon bi-sulphide.

In addition to the above trial, 21 varieties of onions and 11 varieties of leeks were tested.

All varieties which have been tried, both of onions and leeks, have proved to be susceptible, though the latter were much less so than the former. It is a curious fact that at Wylam-on-Tyne leeks have always proved to be only slightly susceptible to smut, whereas at Crookham-on-Tweed the contrary is asserted to be the case. Until the above trials were laid down it seemed likely that this marked resistance of leeks to smut at Wylam was connected with the fact that at this centre, leeks have been grown for seed (known as Wylam seed) for many years; in this way a resistant variety might have been produced by unconscious selection. The result of the trials, however, appears to have negatived this view, and renders it extremely difficult to account for the difference in susceptibility of leeks at the two centres.

"White Lisbon" Onion (the variety used throughout these experiments), though extremely susceptible, is so rapid a grower, that, given good growing weather, it probably suffers less than any other variety. In bad seasons, however, the entire crop may be lost, *e.g.*, in one case *the normal expectation was a crop of ten thousand bunches of five plants each—the actual crop pulled was 200 plants.*

Formaldehyde Experiment.—On 31st July, 1920, a trial was laid down by the Ministry of Agriculture and Fisheries at Wylam, under the charge of the District Inspector. The object was to test the value of the formaldehyde treatment which has proved of considerable efficacy in the United States.

A quarter of an acre of affected land was sown with White Lisbon seed by means of a Planet Junior drill, and a solution of formaldehyde (one pint to sixteen gallons of water) was applied immediately after to the open drill by means of an ordinary watering can with a fine rose. Three and a quarter pints of the solution were used, costing 17s. 10d. The drills were covered, but wet weather setting in prevented rolling. Another portion of the plot (50 sq. yd.) was sown in the same way, but without formaldehyde treatment.

The ground was inspected 6 weeks later. On the untreated portion 95 per cent. of the plants were affected with smut, very few showing signs of being able to recover. On the treated portion careful countings showed that 20 per cent. of the plants were infected, or had been infected. Some were apparently dying, but others appeared to be recovering. The treated portion

as a whole looked much healthier and greener, and was altogether more vigorous.

The garden was again visited by the Inspector on Nov. 14th, when no disease was present either on the treated or untreated portions. The estimated crop on the treated area was 10,000 bunches, a fair average for such a crop being 12,000 bunches. On the control portion not more than a quarter of a crop existed. It is believed that if wet weather had not followed immediately after sowing, the formaldehyde treatment would have been even more effective.

The experiments are being continued by the Ministry.

Summary.—From the above experiments it is clear that the most effective treatment against Onion Smut is undoubtedly the application of formaldehyde to the open drill, the spores of the fungus present in the soil being prevented from infecting the germinating seed, either because they are killed or are temporarily paralysed. That the latter may be the more likely reason is indicated by the failure of the 1915 trial, when application of a much stronger solution a fortnight before sowing proved ineffective. In the United States the application is made by means of a receptacle attached between the handles of the drill. The solution is fed into the drill from an open pipe which is sufficiently long to prevent splashing of the liquid. Further search for resistant varieties will probably be repaid.

The writer desires to express his thanks to Mr. John Mordue, of Wylam-on-Tyne for placing land and labour at his disposal, and to Mr. Fred Dawson for the care he has taken in carrying out the trials.

THE GREY FIELD SLUG.

(*Agriolimax agrestis*, Linn.)

HERBERT W. MILES, N.D.A., F.E.S.

THE Grey Field Slug is common in Europe, and is a well-known pest of gardens and cultivated land in the British Isles, where it was first recorded in the 17th century. Its habits are such that world-wide distribution has been effected, and it is established in most countries, having gained admittance with agricultural produce and with bales and packages in which shelter in damp straw, moss or sacking was obtainable.

Feeding Habits.—Slugs feed chiefly in the evenings, during the night, and in the early morning. They commence at about 9.30 p.m. (G.M.T.), and on misty mornings will feed as late as 9 a.m. They feed omnivorously on growing plants, decaying vegetation and organic matter, and at times on aphids, small earthworms and weakly soil grubs. Feeding takes place both in the soil and on the surface, and at times on the vegetation above the soil. Messrs. Lovett and Black,* of the Agricultural College, Corvallis, Oregon, U.S.A., sum up the feeding activities of slugs as follows:—

> "The attack is most frequent on plants. It is during the early growth that serious injury occurs. Young plants just pushing through the ground are consumed entirely; the foliage of plants in cold-frames and of newly transplanted cabbage, lettuce and tomatoes is devoured or great ragged holes eaten through it. They destroy sprouting corn or tunnel into the base of the older corn, killing or devitalizing it. Field peas, young clover, hops and similar crops adjacent to uncleared areas are often wiped out entirely for a distance of several yards from the border of the field. They eat the leaves, buds, blossoms and fruit of strawberries; injure the blossoms of many ornamentals; disgust one constantly by their repulsive presence; and everywhere leave behind their disagreeable trail of slime."

The attack is perhaps most important among seedlings, particularly when they destroy the seed leaves and growing points. Vegetation and crops everywhere suffer from the depredations of slugs, winter corn being very susceptible to their attacks. When feeding on corn, evidence of their attack may be found in the fact that the leaves of numbers of plants have been eaten away, the thready vascular strands remaining behind and giving the whole plant a ragged effect. The year

* Station Bulletin 170, "The Grey Garden Slug."

1920 was particularly favourable to slugs, and therefore during the past winter many fields of cereals suffered from their attack. The damage to plants was distinctly noticeable in the Bristol district, and examination showed large numbers of slugs in the soil, beneath clods, under stones, root residues and the like.

In moist, showery weather, when vegetation is very damp, slugs crawl about on their food plants and feed quite openly, but in the dry weather they feed low down amongst the leaves near the ground, and in very densely foliaged plants, like cabbage, they get inside the "heart" and feed where it is more moist, and therefore more suited to their requirements. In particularly bad attacks, slugs may tunnel into plants below the surface of the ground; root crops and tubers suffer most in this connection. Instances have been cited where damage to gooseberries and currants has been quite serious; this happens occasionally after continued heavy rains. Though most plants are attacked by slugs, certain weeds seem to be consistently selected as their food plants. These include charlock, cresses, garlic mustard, docks and nettles.

Description and Life History.—The adult grey field slug varies in colour from pale-grey, through dark-grey to brown, and occasionally yellow. When extended it measures up to 2 in. in length; the most common length, however, is 1½ in. The tail end tapers off, while the head is blunt and bears two pairs of retractile tentacles. Below, and behind, these tentacles is the mouth, which has a fleshy lip above and a rasping organ, the radula, below. This organ is furnished with a mass of blunt teeth, by means of which the plant tissue is rasped or scraped away, the vascular strands being left. A short distance behind the head is an irregularly oval mass, the mantle, associated with the small rudimentary shell. The mantle, in which is located the respiratory orifice, is generally darker in colour than the body, above which it is slightly, but distinctly raised. From the mantle to the tail the body has reticulate markings which are less distinct towards the sides.

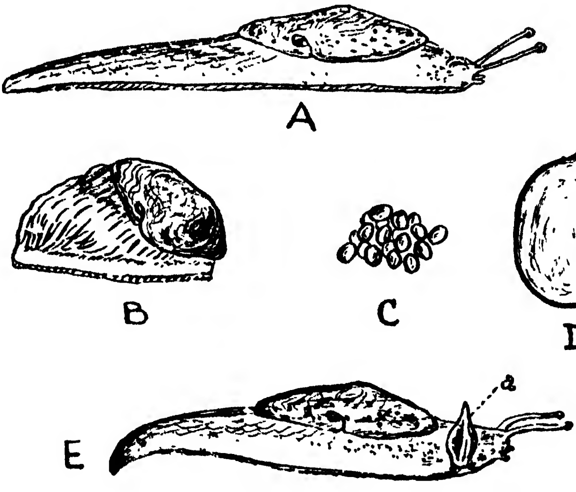
The body is rounded above, but below it has a flattened surface, the sole or foot, which is readily distinguished as it is lighter in colour than the body. The sides of the sole are provided with tubercles, the whole structure being distinct from the body which lies above it. A viscous mucus is secreted from slime glands located in the skin. According to Taylor,* the slime is "often clear when crawling but

* "Land and Fresh Water Molluscs of the British Isles."

becoming milky white on irritation, due to innumerable particles of carbonate of lime."

Slugs, like snails and allied forms, are hermaphrodite. The sex organs are located on the right side, just behind the head; when mating these are extruded and become swollen, distended and globular, the colour being whitish with a tinge of blue. Mating takes place early in the morning, between 4 a.m. and 6 a.m., especially on wet or misty mornings, when the ground is very wet. After mating the slugs retreat and hide in tunnels and crevices in the soil.

Egg-laying commences about a fortnight or three weeks after mating, the adult becoming quiescent shortly before the ova



A.—Adult slug extended. B.—Slug contracted.
C.—Cluster of Eggs. D.—Egg enlarged.
E.—Adult slug extended, with sex organs (*a*) extruded.

are deposited. The eggs, which are elliptical and practically transparent, are laid separately, but in clusters of as many as 60, under moss, vegetation and decaying roots. Lovett and Black quote an interesting observation in connection with the egg-laying habits of slugs: " Stock turnips, which had become pithy and split open, were found with great masses of eggs in the fibrous and slightly moist interior."

On hatching, the young slug is whitish in colour. This gradually gives place to pale-grey, which in turn becomes mottled-grey and brownish as development proceeds. The slug attains maturity in from three to four months and may live for two years or longer.

Control.—(*a*) *Effect of Climate.*—Dry weather appears to be antagonistic to slugs to a small extent only, merely driving them to moist situations lower down in the soil or into the depths of dense vegetation. Heavy rains, as such, apparently do not affect them, except that drowning may take place in pools and ruts in roadways, paths and buildings. During cold weather they may go a little deeper in the soil or hide under any available shelter, and become dormant.

(*b*) *Natural Enemies.*—It is probable that the slug has few natural enemies. Insects and fungi are only very seldom found preying on them, and though in 1920 observ tions in Shropshire revealed a number of dead slugs infested with maggots, it is improbable that these were the cause of death. Birds such as the thrush, blackbird, jackdaw and rook have been observed eating slugs, and Collinge* states that slugs and snails form 6.5 per cent of the animal food of starlings. Poultry destroy numbers of slugs, ducks and geese being particularly partial to them.

(*c*) *Combative and Preventive Measures.*—As slugs readily take advantage of all kinds of refuse for shelter in the daytime, it would seem advisable to plough-in crop residues immediately after the removal of the crop, and organic manures as soon as applied. Hedge-brushings and ditch-side vegetation should be destroyed: it should never be allowed to remain in heaps about fields and roadsides. This is specially important during the periods when no crops are available on arable land. All vegetation on waste ground, hedge-, ditch- and pond-sides should be periodically burned. Cleanliness and tidiness in stack-yards, around root clamps, and in gardens should always be maintained, since all material lying about harbours slugs to a remarkable extent.

Trapping, by means of sacks or pieces of board and bark, is effective in gardens and around cold frames. Where slugs are very numerous it might be advisable to apply Bordeaux mixture either as a spray or in the powdered form. This has given good results in America on lettuce, and in the tests carried out by Messrs. Lovett and Black, "Plants sprayed with Bordeaux Mixture 2-2-50 and 4-4-50, respectively, showed very little indication of slug injury for a month after the time of treatment." These workers also tested various stomach poisons and contact irritants, but no very satisfactory or practicable application was forthcoming. Copper sulphate was

* "The Starling," *Jour. Min. of Agric.*, March, 1921.

found to be comparatively effective, but owing to its injuring the foliage it was deemed impracticable. The most satisfactory poison bait consisted of chopped lettuce and calcium arsenate (16:1); this gave good results, a high percentage of slugs being destroyed.

In England, lime, soot and salt have been advocated as dressings against attacks by slugs. Applications of a mixture of equal parts of these constituents between the rows of cabbages and similar crops have been found to give some relief. In view of the fact that slugs have the power of exuding considerable quantities of slime on coming into contact with an irritant, and can successively overcome several irritant dressings in this manner, it is necessary to apply three or four light dressings at short intervals. The best results have followed the repetition of the dressings at hourly intervals in the late evening; where this is impossible, however, applications morning and evening should be effective. Perhaps the greatest factor in slug control is cleanliness; clean farming would undoubtedly tend to keep this widely distributed and exceedingly troublesome pest in check.

SMALL HOLDINGS SECTION AT THE BATH AND WEST SHOW.

THE Bath and West and Southern Counties Society was the first of the big agricultural societies to act upon the suggestion of the Ministry of Agriculture that they should include in their programme special sections for the small cultivator. This they did recently in connection with their Bristol Meeting in June by devoting a section to the interests of the small man on the land. A Sub-Committee was appointed to deal with the Small Holdings Section and the result was the institution of competitions for the best managed small holdings and allotments, an exhibition of matters of special interest to the small cultivator, and an educational programme of instruction. The competitions were judged by Mr. A. R. White, Chairman of the Wiltshire Agriculture Committee and a member of the Bath and West Council. The classes and awards were as follows:—

Class 1.—Small holding of over 15 acres and under 50 acres in Gloucestershire or Somerset (open class). Prizes, £15; £7; £3. (2 entries)—

1. H. Symes, Orchard Farm, Pilning, Bristol; 24 acres.
2. B. Stephens, Court Farm, Watchett, Somerset; 48 acres.

Class 2.—Small holding of over 1 acre and not more than 15 acres in Gloucestershire or Somerset (open class). Prizes, £10; £5; £2. (1 entry)—

2. P. Y. Smith, The Laurels, Parson Street, Bedminster, Bristol; 10½ acres.

Class 3.—Small holding of over 15 acres and under 50 acres in Gloucestershire (open to ex-service men only). Prizes, £15; £7; £3. (3 entries)—

1. H. Symes, Orchard Farm, Pilning, Bristol; 24 acres.
2. A. J. Newman, Court Farm, Winterbourne; 47 acres.
3. D. Pearce, Whychwell Farm, Wapley, Chipping Sodbury; 31 acres.

Class 4.—Small holding over 1 and not more than 15 acres in Gloucestershire (open to ex-service men only). Prizes, £10; £5; £2. (7 entries)—

1. A. J. Kinchin, Mickleton, near Chipping Campden; 4 acres.
2. S. J. Righton, Mickleton, near Chipping Campden; 4 acres.
3. E. Chadband, Mickleton, near Chipping Campden; 5 acres.

Class 5 Small holding over 15 and under 50 acres in Somerset (open to ex-Service men only). Prizes, £15; £7; £3. (10 entries)—

1. R. H. Shire, The Downs, Donyatt, near Ilminster; 50 acres.
2. R. S. Bond, Dimer, Castle Cary; 27 acres.
3. R. W. Fowler, The Crossways, Crock Street, Ilminster; 50 acres.

E. H. T. Vincent, Thrupe Farm, Masbury, Wells; 50 acres.

Class 6.—Small holding over 1 and not more than 15 acres in Somerset (open to ex-service men only). Prizes, £10; £5; £2. (1 entry)—

1. T. Gillingham, Court Farm, Seavington, Ilminstor; 8 acres.

The prize fund was made up by contributions from the President, the Bristol Local Committee, Members of the Small Holdings Committee of Gloucestershire and Somerset and the Bath and West Society. The Championship Shield awarded to the best managed allotment estate was the gift of Mr. Savory, a member of the Bristol Town Council.

The entries in the open classes were somewhat disappointing in number. If similar competitions are instituted elsewhere, the pioneer experience of the Bath and West Society would suggest that the most effective method of securing entries is by personal canvas among likely competitors. This should, of course, be combined with advertisements in the local press, so as to give a fair opportunity of entry to all.

In the classes confined to ex-service men the entries were more numerous and some keen competition resulted, especially in the smaller holdings in Gloucestershire and the larger holdings in Somerset. In Gloucestershire the prizes went to market garden holdings at Mickleton; in Somerset the chief awards were made to small farms near Ilminster.

The Allotments Competition was arranged with the co-operation of the Agricultural Organisation Society in conjunction with the Bristol Federation of Allotment Societies. It should perhaps be explained that there are some 21 allotment societies in the Federation. They include a membership of about 11,000 and an area of 779 acres.

Two classes were provided for individual allotments, one of not less than 10 rods, and the other of an area from 10 to 20 rods. There were 325 entries for these, and the intention is to award a first prize among the entries from each allotment estate and then to judge the prize winners for a champion prize in each case. The individual allotments are being inspected twice and the final award will be made at the end of July or the beginning of August.

There was also a class for the best managed allotment estate. For this there were 11 entries. The Challenge Shield was awarded to Fishponds Allotments Limited, with the Bedminster and Bristlington Societies a good second and third. The judging was undertaken by Mr. Hollingworth and Mr. Turner, the Horticultural Organisers for the counties of Gloucestershire and Somerset respectively.

The Exhibition was housed in a special pavilion provided by the Society. It included models and photographs of small holdings homesteads shown by the Ministry and the Somerset County Council. The Essex County Council also lent a small but very attractive model of a thatched cottage, which was in sections, to facilitate examination. The Ministry's leaflets and guides of particular interest to small holders were also available for distribution. An attempt was made to secure a joint exhibit from the Education Committees of the Gloucestershire and Somerset County Councils which would show the small holder what the local authorities were able to do for him in the way of agricultural education and advice, but on account of the expense the Somerset Council did not see their way to co-operate. The Gloucestershire County Council supplied an exhibit and arranged for their horticultural and poultry lecturers to be available during the whole time of the Show to answer enquiries and give information. This exhibit was of particular value and the lecturers were constantly surrounded by an eager party of inquirers.

An exhibit illustrative of co-operative methods of marketing was supplied by the Street and District Egg Collecting Society, members of the Committee of which were present to explain the Society's procedure. A demonstration of the day-old chick trade, an exhibit of hand implements for the small holding and the allotment, and an exhibit of bee-keeping appliances, added considerably to the interest of the Section.

In the case of every exhibit there was someone present to answer inquiries, and this proved a very satisfactory feature of the work of the Section.

The Allotments side was aided by a poster prepared by Mr. Randall, local Allotments Organiser of the Agricultural Organisation Society, setting out the work of the Federation and the prizes offered for competition among its members, and by a large pictorial diagram, specially prepared by Messrs. Sutton & Sons, showing the cropping of the Ministry's model allotment as described in Leaflet No. 315. It was originally intended to have an actual model allotment planted up on the Show ground, and

this Messrs. Sutton had kindly offered to undertake, but as on careful consideration questions of site and danger from late frosts were thought to render the proposal too risky, the diagram referred to was substituted.

In connection with the Section, a demonstration of the method of producing clean milk (*i.e.*, free from bacteria) was undertaken by Reading University. A special building was provided near the Small Holdings Pavilion and demonstrations were given twice daily during the Show. This was the first time that this demonstration had been held in a show yard, and when the usual minor difficulties had been overcome it proved a centre of considerable attraction to large numbers of people. It is probable, however, that such a demonstration would be more appropriately situated near the cattle lines, so that the cows for demonstration purposes might be more readily available and the herdsmen themselves might be interested.

The programme of the Section was completed by a series of "short talks" on such subjects of interest to small holders as "The Small Holder's Live Stock" and "The Small Holder's Bees."

Altogether, the Small Holders' Section has undoubtedly been a great success from all points of view. The interest taken in it both by press and public was very great, and much useful work was accomplished and helpful information given.

ERADICATING GALL MITE (BIG BUD) FROM BLACK CURRANT STOCKS.

H. GOUDE, N.D.Hort.,
Horticultural Adviser to the Norfolk County Council.

THE question of raising clean stocks of black currant bushes has been a problem in horticultural circles for a generation. The failure to do so is undoubtedly the cause of the annual propagation of the disease and its distribution to all districts where black currants are cultivated. The assurance that bushes for planting are free from " big bud " is of little practical value; the important point is whether they are free from " mite." None of the stocks that I have examined during the past seventeen years have been entirely free from " mite." The infestation was seldom so severe as to cause " big bud " in one- or two-year old bushes, but "big bud " would develop as soon as the bushes were subjected to the strain of faulty cultivation, adverse weather, or fruit bearing. The plantation then becomes unprofitable and is usually grubbed up.

Where a clean start can be made and the plantation established as far as possible away from all source of infection, the stock would remain free from " mite." Where it is not possible to secure this condition, clean planted bushes have remained free from " big bud " for seven years, even though planted side by side with infected bushes, and have at least six or seven years of profitable life before them, proving the value of an absolutely clean start. At the present time it is the exception to see profitable plantations twelve years old. Most cultivators have adopted the method of close planting and grubbing up the bushes as soon as they develop " mite " or " reversion." In this way the establishing cost is a frequently recurring charge on the cultivation of the crop, and what should be the heaviest fruiting years—the fifth, sixth and seventh—in the life of a plantation are lost.

The unfruitful condition known as " reversion " is prevalent in most plantations. Many observant cultivators associate this disease with an attack of " mite." True " reversion " has been observed in seedlings, proving that " mite " is not the sole cause. The toxic effect of the parasite on the sap is a probable contributory factor. The black currant is, like the asparagus plant, very much influenced by checks to growth, and any serious check, or, more particularly, combination of

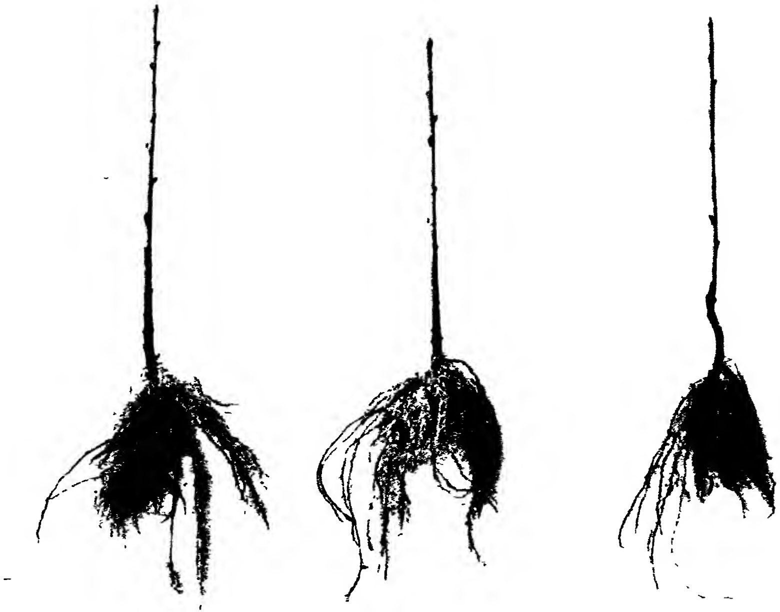


Fig. 2. Illustration of Black Currant Plants rooted in June from soft cuttings.

checks, to the normal growth of the plantation will start "reversion" in a wholesale manner. The causal agent, if there is one, may be able to develop while the bush is under the stress of adverse conditions.

It is hardly necessary to go into the details of the history of the "mite"; the only knowledge in this respect that cultivators appear to be interested in is how to get rid of the trouble. To raise clean bushes a start must be made during April and May, when green shoots should be taken from the bushes and rooted in a cold frame. This is the only period in the year when shoots carry no "mites" in the buds. The embryo buds are undeveloped, and offer no harbour for them.

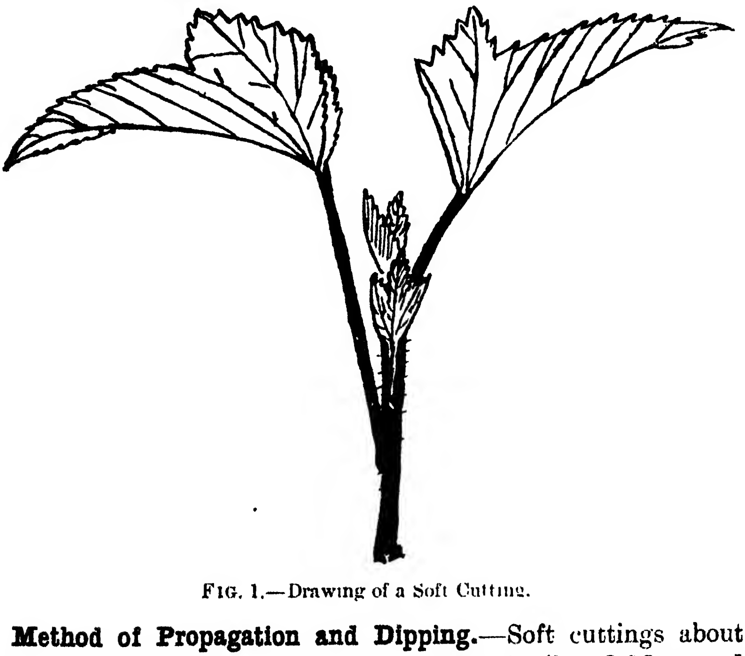


FIG. 1.—Drawing of a Soft Cutting.

Method of Propagation and Dipping.—Soft cuttings about three inches long should be taken during April and May, and soaked in a bath of insecticide, viz.:—

Nicotine 98 per cent	½ oz.
Soft Soap	4 oz.
Soft Water	5 gal.

This dipping kills any external "mites" the shoots may carry. After an hour's soaking the cuttings should be taken out, rinsed in clean water, and dibbled firmly six inches apart in a cold frame. The frame should be closed, shaded from the sun, and the cuttings treated as soft cuttings until rooted, which will

be in about a month. Gradual hardening should follow and the frame should eventually be lifted off to ripen the wood fully. The cuttings strike freely in small pots, from which they can be planted out when rooted to grow.

In the autumn the plants from the frames can be planted in a nursery, cutting back slightly to induce the basal buds to break strongly. By this method clean-stock bushes are provided for furnishing cuttings for the usual method of propagation, or they can be used for planting in fields direct from the frames. Major Evans Lombe tested these young plants at Marlingford under field conditions with good yearling plants raised from ripe wood. The plants from soft cuttings started growing earlier, and are now the larger plants. The photograph (Fig. 2) illustrates plants raised by Major Evans Lombe. The root system developed by the soft cuttings is a notable feature of this method.

Large numbers of cuttings can be taken from established bushes without detriment to the crop. The side shoots should be taken, leaving the terminals for producing the following season's fruiting wood. Although April and May are the best months for striking quantities of cuttings, the soft growing points of the shoots will strike through the growing season, but it is not advisable after August. If the wood has begun to harden there is a danger of the buds containing "mites," which have a preference for the terminal bud, and during June and July are found in large numbers on infected bushes at the apical ends of the shoots, and between the leaf stalk bases and developing buds.

Propagating from soft cuttings offers a means of rapidly increasing varieties of which stocks are low, and offers possibilities of raising clean stock in plants subject to perennial diseases. Red and white currant bushes are not uncommonly tainted with the same gall mite that infects black currants, and this should not be overlooked as a possible source of re-infection to clean stock.

NOTES ON FEEDING STUFFS FOR AUGUST.

E. T. HALNAN, M.A.,
Ministry of Agriculture and Fisheries.

Condemned Condensed Milk.—Numerous correspondents have written as to the feeding value and best method of feeding condemned condensed milk, large quantities of which appear to be available. In using any food of this nature for stock, it is advisable to start cautiously at first in order to avoid the possibility of poisoning the stock. Several breeders of repute have used this condemned condensed milk for their stock, and it is apparently most suitable for pigs. Pigs of all ages have been fed successfully, and a feeding trial at Moulton Farm, carried out by Mr. W. A. Stewart, Agricultural Organiser for Northamptonshire, demonstrated its value for pigs of all ages. This milk used in the right proportions proved of particular value for weanling pigs.

Method of Use.—The tins are spiked both ends and dropped into warm water to dissolve out the contents, after which the tins are raked out and the liquid mixed with the other food. The quantities fed should be at the rate of ⅛ tin per weanling pig, gradually increasing in amount until the adult pig receives ½ tin. These are the maximum quantities recommended. At present prices, the writer is of opinion that condemned condensed milk should be restricted to weanlings and young growing pigs.

Feeding Value of Condemned Condensed Milk.—The feeding value of condensed milk varies considerably with the brand of milk sold. Assuming that the milk is practically all digestible, and that the animal obtains full value from the digestible nutrients, sweetened full-cream condensed milk has a starch equivalent of 86, sweetened skim condensed milk has a starch equivalent of 70, and unsweetened condensed milk has a starch equivalent of 57. Compared with the market price of other feeding stuffs, the actual food value of the three grades of milk given above works out roughly at 1d. per tin for the unsweetened condensed milk, 1¼d. per tin for the sweetened skim condensed milk, and 1½d. per tin for the sweetened full-cream condensed milk. The actual purchaser must assess for himself the extra money he is prepared to give for any special dietetic value this food may possess for young growing pigs. A tin of condensed

NAME.	Price. s.	Price. lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	46/-	400	12 18	1 6	11 12	71	3/3	1·74
„ Canadian „	47/-	400	13 3	1 6	11 17	71	3/4	1·78
Oats, English „	46/-	336	15 7	1 9	13 18	59·5	4/8	2·50
„ Foreign „	33/-	320	11 11	1 9	10 2	59·5	3/5	1·83
Maize, Argentine	47/-	480	10 19	1 5	9 14	81	2/5	1·29
Beans, English spring	95/-	532	20 0	3 1	16 19	66	5/2	2·77
„ „ winter	55/6	532	11 14	3 1	8 13	66	2/7	1·38
„ Rangoon	8/-	112	8 0	3 1	4 19	66	1/6	0·80
Peas, English blue	59/-	504	13 2	2 13	10 9	69	3/-	1·61
„ „ dun	80/-	504	17 16	2 13	15 3	69	4/5	2·37
„ „ maple	93/-	504	20 13	2 13	18 0	69	5/3	2·81
Buckwheat	86/-	392	24 11	1 9	23 2	55	8/9	4·69
Rye, English	59/-	480	13 15	1 8	12 7	72	3/5	1·83
Millers' offals—Bran	—	—	7 5	2 10	4 15	45	2/1	1·12
„ „ Coarse middlings	—	—	11 5	2 10	8 15	64	2/9	1·47
Barley meal	—	—	14 15	1 6	13 9	71	3/9	2·01
Maize „	—	—	10 12	1 5	9 7	81	2/4	1·25
Fish „	—	—	19 0	7 12	11 8	53	4/4	2·32
Linseed	—	—	21 10	2 16	18 14	119	3/2	1·70
„ Cake, English	—	—	15 15	3 12	12 3	74	3/3	1·74
Cotton seed „ „	—	—	10 0	3 5	6 15	42	3/3	1·74
„ „ decorticated	—	—	13 0	5 6	7 14	71	2/2	1·16
„ Meal, decorticated	—	—	11 10	5 6	6 4	71	1/9	0·94
Coconut cake	—	—	10 6	3 0	7 6	79	1/10	0·98
Groundnut cake	—	—	10 0	3 9	6 11	57	2/3	1·20
Palm kernel cake	—	—	8 10	2 1	6 9	75	1/9	0·94
Brewers' grains, dried, ale	—	—	7 5	2 7	4 18	49	2/-	1·07
„ „ wet „	—	—	0 18	0 12	0 6	15	0/5	0·22
Distillers' „ dried	—	—	9 5	2 16	6 9	57	2/3	1·20
Malt culms	—	—	7 5	3 6	3 19	43	1/10	0·98
Potatoes *	—	—	2 11	0 8	2 3	18	2/5	1·29
Swedes *	—	—	1 2	0 5	0 17	7	2/5	1·29
Mangolds *	—	—	1 0	0 6	0 14	6	2/5	1·29
Vetch Oat and Silage *	—	—	2 9	0 15	1 14	14	2/5	1·29

* Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

milk weighs approximately 14 oz., and 2,560 tins contain roughly a ton of condensed milk, and from these data the purchaser can

assess the actual cost to him of the milk at present market prices. Maize meal, rice meal, pollards and bran would form suitable foods to feed in conjunction with this material.

Bully Beef and Egg Yolk.—Two other waste materials are at present in use for pigs, *i.e.*, condemned bully beef and liquid and dried egg yolk. Users of both these materials have fed them successfully to pigs, the chief point to remember being that these substances are highly nitrogenous foods and should therefore not bulk largely in the ration. Liquid egg yolk also contains much water and occasionally a fair percentage of boric acid.

Value of Fodder Crops for Dry Seasons.—The dry weather experienced lately has emphasised the value to the dairy farmer in particular, and to stock breeders in general, of planting a breadth of vetches and oats, cabbage, or maize as a supplementary succulent feed in periods of drought. The vetches and oats and cabbage will be available in the earlier summer months, the maize during August. This practice is fairly common in certain districts, and the farmers who have adopted it for this season have been relieved of the anxiety as to feed for their stock.

AGRICULTURE ABROAD.

POSITION AND PROSPECTS OF ITALIAN AGRICULTURE—AGRICULTURAL BOOK-KEEPING IN DENMARK—AGRICULTURAL CO-OPERATION IN SAXONY—IMPORTATION OF SEEDS INTO SWEDEN—PRUSSIAN PROGRAMME OF AGRICULTURE.

ACCORDING to a report issued by the Commercial Counsellor and the Commercial Secretary to H.M. Embassy at Rome.*

Position and Prospects of Agriculture in Italy.

Italian agriculture, by reason of the increase in the population, has almost reached its territorial limits, and any increase in the cultivable area will depend upon the reclamation of land by drainage. Already the agricultural and forestal productive areas represent 91.1 per cent. of the geographical area of the country.

According to the report, the War temporarily arrested the development of agriculture,† but a significant recovery in the yield of some of the products for export took place in 1920. Being at the outset of the War less well equipped than other countries to bear the strain, Italy suffered in a special degree from exhaustion, disorganisation and impoverishment. Before the War her economic position was sound. Agriculture was, and still is, her greatest industry: it gave occupation to more than one-third of the population: agricultural products formed the biggest item in her exports. At the present moment the cost of imported agricultural produce is the heaviest item in national expenditure.

Owing to the great density of the population (332 per square mile), *wheat* has been cultivated on land which is more adapted for woods and pastures, and the wheat cultivated area has reached 16 per cent. of the territorial surface. A pamphlet published recently by the Italian Ministry of Agriculture states that, during the twelve years 1909-1920, the wheat crop has varied from a maximum of 27 million quarters in 1913 to a minimum of 17 million quarters in 1917, with an average of 21 million. It has been deduced that Italy is not particu-

* General Report on the Commercial, Industrial and Economic Situation of Italy in December, 1920, obtainable for H.M. Stationery Office, Kingsway, W.C.2. Price 1s. net

† Italy differs greatly in this respect from some of the other combatant countries, in which phenomenal development in agriculture took place and greater quantities of foodstuffs than ever before were raised. The success attending the war efforts of Great Britain are well known, while this *Journal* for May told briefly what had been done in Canada.

larly adapted for the cultivation of wheat, especially on account of the heat and drought to which much of the land is subject. Better methods of cultivation, and, in particular, the growth of leguminous plants, which serve both to feed cattle and improve the land, would go far, it is believed, to overcome climatic disadvantages and raise the average of production. According to the most recent official estimate for the year 1920-1921, the total national requirements of wheat, including seed (of which 3 million quarters are required), are 30 million quarters. This will be provided as follows:—Home-grown wheat, 17½ million quarters; Foreign wheat, 12½ million quarters.

Among the other crops mentioned in the report, *maize*, with a yield in 1920 of 10 million quarters, still occupies an area of about one-third of that of wheat, although it is diminishing. *Tobacco*, which is a State monopoly, resulted in a yield of 246,000 cwt. in 1920. *Beetroot*, a recent introduction, is now cultivated on a large scale, the yield in 1920 being 29 million cwt., and allows for the production of sugar by national factories in quantities almost sufficient for the requirements of the country. The yield of *oats* was 2½ million quarters; *barley*, 700,000 quarters; *rye*, over 500,000 quarters: and *potatoes*, 1,400,000 tons. The export of *dried vegetables*, which in pre-war days reached nearly 600,000 cwt. a year, fell to 427,000 cwt. in 1919. The total yield of *pulse plants*, which are now cultivated in several districts, is about 14 million cwt. The growth of forage has been increased and now attains a production of over 450,000 cwt.

Italy's stock of animals has increased since 1908. Horses and asses each number about a million; mules, half-a-million; cattle, 6¼ million; swine, 2¾ million; sheep, 11¾ million; and goats, 3 million.

Among the projects for developing the commercial relations between Italy and the United Kingdom is one for the establishment of a rapid overland service for the carriage of perishable goods, especially fruit and vegetables, similar to that which existed before the war between Italy and the Central Empires. Agriculturists contend that the future of Italy lies in agriculture. Her natural resources and advantages are still what they were, and though weakened by her war efforts, as well as by labour troubles after the War, it is confidently believed that there is no reason why she should not regain her former position. The very important hydro-electric plants

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which are being constructed in various parts of the country are expected to give a great impetus to agriculture by assuring a greater measure of security as regards irrigation. Assurance of progress is also given by the increased national production of chemical fertilisers and agricultural machinery, and the establishment of new schools and travelling boards for the education of farmers in modern methods of cultivation. Perhaps the most successful branch of the co-operative movement, which is extending rapidly and receives the active support of the Italian Government, is agricultural co-operation in the form of collective farms, established principally in the North and in Sicily; these have been found in most cases to result in an increase of production and of the number of persons who can live on the land.

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Agricultural Book-keeping in Denmark.

AT the suggestion of the Royal Danish Agricultural Society, supported by the principal agricultural societies and the Department of Statistics, Professor O. H. Larsen, of the Royal Danish Veterinary and Agricultural School, has established a Central Office of Agricultural Book-keeping, of which he is head, and an article by him on the subject appears in the Monthly Bulletin (March, 1920) of Agricultural Intelligence issued by the International Institute of Agriculture at Rome.

One of the objects of the Central Office is the elaboration of the account books kept by local societies, with whom it is collaborating with a view to ensuring that only the most suitable books shall be kept. In order to obtain uniformity and reliability the local accountants meet periodically at the Central Office to discuss the systems on which the books are kept. Another object of the Central Office is to ascertain the amount of capital invested and how it is allotted among the various agricultural enterprises It also seeks to compile a comprehensive budget of gross profits, working expenses, net profits and interest on capital, and to show the cost of production, general working expenses (including those of horses and implements), household expenses, and the revenue yielded.

The Central Office was opened in the spring of 1916. During the first two years the work was of a preparatory nature, but by the year 1919-1920 collaboration with 29 societies had been effected, and it was believed that the number of account books requiring elaboration would be 350. The Office is under the

supervision of seven members representing the societies and institutions which took part in its foundation, and the staff also includes a consulting accountant, a permanent assistant and temporary officers. For the first two years the Office was maintained by the Royal Danish Agricultural Society, but afterwards it received a State subsidy, and contributions from the local societies. Some of these receive, in addition to free supplies of account books, a bonus for books containing data useful to the Central Office: others which correspond direct with the Office and receive book-keeping assistance from it, pay contributions in proportion to their size and to the extent of the book-keeping assistance received.

The origin of local societies for agricultural book-keeping dates from the beginning of the twentieth century, and was due partly to the control societies that have existed since 1895, and partly to farm competitions. In 1918 there were 670 control societies, whose chief object was the fostering of the dairy industry. They kept accounts of milk production and of the content of butter-fat as well as of the fodder consumed by each dairy cow placed under their control: they were thus in a position to indicate the most profitable animals. Sometimes their book-keeping extended to the feeding and growth of horses. These were the first steps towards a complete system of farm book-keeping. From 1902 till 1908 prize competitions were held in the island of Samso for the best-kept books covering various crops. In following years similar competitions were held in other parts of Denmark, and as interest in agricultural accounts grew, more branches of the farm were brought under book-keeping control.

The system of book-keeping used by most local societies and circuits is that issued in 1913 by the Royal Danish Agricultural Society. A typical circuit does its work thus: the society engages an accountant, who helps members to establish the system, guides them in making the daily entries, makes up the work book and the monthly cash and fodder accounts, draws up the yearly balance sheet and makes a detailed analysis of all accounts. The fees which the society charges its members vary from about 6d. to 1s. 1½d. per 2½ acres of the farm. Usually a circuit covers a small area, so that one accountant is able to visit each farm in his circuit as often as required, with the exception of the busiest time, when some assistance is needed. There are, however, circuits having more than 1,000 members. Since 1915 the societies can apply

for a State subsidy amounting to one-half the salary, office and travelling expenses of the accountant, provided that the Government standard of book-keeping is adopted and the balance sheets are published. The number of State-subsidised circuits for the financial year 1918-1919 was about 30 and included 1,094 farms with a total of over 108,000 acres; in 1919 the figures were much higher.

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Agricultural Co-operation in Saxony.

ACCORDING to an account, based on press reports, received from H.M. Consul at Leipzig through the Foreign Office, the Union of Co-operative Societies in Saxony, which 30 years ago comprised 24 societies, now includes 588 societies, having a membership of over 50,000 (that is, almost 75 per cent. of the independent farmers of Saxony) and a turnover of over 2,000 million marks. The total capital of the associations amounts to nearly 300 million marks. The Union includes no fewer than 405 mutual loan societies having a turnover in 1919 of 628 million marks. In the same year the turnover of the trading co-operative societies amounted to 354 million marks. The quantity of milk delivered by the dairy co-operative societies in 1914 was 55 million litres (over 12 million gallons), but owing to the War the amount has decreased by more than one-half.

The pasture societies, which are peculiar to Saxony, are considered to be of great importance at the present time in the rearing of young cattle. Their total expanse of pasture land is 653 hectares (about 1,614 acres) and 266 animals were reared in 1919.

The supply of raw materials obtained by the Union in 1919 was nearly three million cwt., which is only half its pre-war level. There are approximately 420 storehouses, having a storage capacity of 50,000 tons, at the disposal of the associations. An extension of the financial business of the societies, in the form of village banks, is foreshadowed.

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Importation of Seeds into Sweden.

A SWEDISH Royal Proclamation, dated 18th March, 1921, prohibits, under severe penalties, as from 21st March, 1921, the import into Sweden of the following:—Seeds of Timothy grass; Red clover and similar classes not particularly named; Hybrid- and white-clover; Cocksfoot; Rye-grass; Carrot, Swedish turnip; beetroot and rape; kitchen garden produce; and all seeds

exclusive of flower seeds, canary seed, pine and fir seed, hemp seed, flax seed, lupine, rape seed and seeds of all other oil plants.

As originally published, the Proclamation included flower seeds. A later Decree, however, rectified this and exempted them as from 4th April, 1921, from the import prohibition. Flower seeds may therefore be imported into Sweden.

* * * * * *

Prussian Programme of Agriculture.

IN introducing his new programme to the Prussian Landtag, Herr Warmbold, the Minister of Agriculture, stated that as agricultural production is at the present time only about 60 or 70 per cent. of that of prewar days, certain measures are proposed with a view to increasing production up to the pre-war standard. These included a larger number of land settlements, which would, it is hoped, by increasing the number of small owners, attract people from the towns to the land and keep them there. The agricultural population was decreasing rapidly even before the War: in 1914 it was only about 28 per cent. of the whole Prussian population. It was hoped to create 4,000 new settlements in 1921. It is proposed that increased production of the soil already cultivated shall be encouraged by more State credits to farmers for purchasing fertilisers, while moors and waste land, particularly around the coasts, will be prepared for cultivation. The production of nitrates, which has lately been increased greatly, will have to be devoted entirely to the needs of agriculture. The working capital of farmers should in urgent cases be assisted by State credits. The number of schools of agriculture would have to be increased and the curriculum improved; and there was need of greater security for agriculturists and peasants against looting, theft and other risks. The present system of arbitration between employer and labourer also needed revising.

Report for 1919 on Plant Pests.

A REPORT on the occurrence of insect and fungus pests on plants in England and Wales for the year 1919 was recently issued by the Ministry. This publication was delayed through unavoidable circumstances, but its chief value—to preserve in permanent record a detailed survey of the situation in regard to plant pests year by year—is achieved.

In the year in question Frit Fly caused heavy losses, though these were perhaps not quite so serious as the wet character of the spring and the consequent delay in the sowing of oats would have suggested. The North Midland Counties seem to have

suffered most and the Southern Counties least, probably because in the south the oats grew away very rapidly during the latter half of May. The attacks of Frit Fly in winter wheat occurred in crops sown on ploughed-up grass, especially on rye-grass leys. Other insect attacks on cereals are noted, the drought in May and June combined with late sowing of Spring crops being held responsible for some of them. In the case of roots, it is noted that during the drought in early summer widespread damage was done by Flea Bettles; mangolds suffered especially, the difficulty being much increased by the slow and irregular germination which occurred during the drought.

With regard to fruit, the most notable occurrence of the year 1919 was the outbreak of the Lackey Moth, which occurred in the Sittingbourne area of Kent, and to a lesser, though nevertheless serious, extent in other Southern and Midland Counties. In the Sittingbourne area well over 1,000 acres of fruit were involved. In the worst cases, hundreds of men and women were employed to fight the attack, with the result that perhaps half of the crop may have been saved. The cost of the necessary labour to the growers, however, added a heavy outlay to other charges, and coupled with the loss of half the crop, made the business far from profitable for that season to the particular growers concerned. One grower is said to have spent £1,000 on labour in dealing with this pest alone. Winter Moths were rather less destructive than usual in the chief fruit-growing areas, except perhaps in South Devonshire. The Ermine Moth, a web-making species, like the Lackey Moth, was abnormally harmful and called for special attention in many districts. The Capsids did considerable damage to apples, notably from Wisbech northwards into Lincolnshire. Some divergence of opinion as to the results of limewashing for this pest is reported, but nicotine in all cases appears to have been reasonably effective.

The situation with regard to attacks of fungi, bacteria, etc., in the year 1919 is also dealt with. Broadly speaking, little information has been available with regard to the distribution of these pests and the losses they bring about in this country. Comparing the Report for 1919 with those for 1917 and 1918, it is at once clear that much progress has been made. The list of authenticated fungus diseases noted in the Report numbers 255, not including fungi in which the attacks are trivial or occur only under special conditions. With regard to fungus diseases in cereals, excellent results were obtained against Bunt and Smut by proper pickling. Reports show

that through neglect of this precaution many thousands of bushels of wheat, barley and oats were lost. Important facts with regard to the outbreak of Black Rust on wheat in South West Wales were discovered, notably in connection with the presence of the alternate host, Barberry, in the area.

For fuller and more detailed information on insect and fungus attacks on plants in 1919, reference must be made to the Report itself, which gives, incidentally, some valuable information as to the best known means of controlling the attacks. This is the aspect of the matter which is of most importance to the grower, and the Ministry will always be glad to advise those in need of remedies for plant pests. The Report can be obtained on application to the Ministry, price 1s. 6d. net, post free.

* * * * * *

Cultivation of Lavender.

HISTORY has it that lavender was introduced into England in the year 1568, and that for a long time thereafter the home crop supplied the bulk of the lavender oil used in this country. In comparatively recent times, however, the industry of lavender-growing was sorely hit by a disease of the plant, and this had the effect of very much reducing the area under the crop and increasing the importation of lavender from France and other countries. The quality of the imported produce, however, was not so good as that grown at home and commanded a lower price on our markets.

The cultivation of the plant in this country is centred more or less round London, and the Mitcham produce is world-famous for the quality and fragrance of its oil. The plant flourishes best on a warm, well-drained medium loam with a slope to the south or south-west. A loam that is too rich is detrimental to the oil yield, as excessive nourishment tends to the growth of leaf. Protection against summer gales by a copse or wood on the south-west is also of considerable value, as these gales may do great damage to the crop by causing the tall spikes to break away at their junction with the stem.

As to cultivation, in the autumn the land should first be carefully cleaned of weeds, which should be burnt. The ashes should be distributed over the ground, together with some ordinary wood ashes if obtainable. The soil should then be prepared by "trenching in" a quantity of short straw and stable refuse, but not much rich dung, and should lie fallow until the following spring, when any weeds remaining should be dealt with as before and the whole ploughed over. Towards late

spring the young plants should be "dibbled in" in rows running from north to south, 4 feet apart and 6 feet between the rows. These wide spaces are not more than is necessary to allow the plant full growth for flower-bearing, room for cutting flowers and for keeping the ground free from weeds.

The crop is propagated from "cuttings" broken off with a root or heel, and planted in March, April or September. The "cuttings" should be of young growth, and should first of all be planted 3 or 4 inches apart in a shady spot and kept watered. In the following spring they can be transplanted to their proper positions in the field. Weeds should be destroyed regularly, but the hoeing should be not more than one inch deep as the roots of the plant spread near the surface of the ground. Young plants should as far as possible be kept from flowering during the first year by clipping, so that the strength of the plant is thrown into the lateral shoots to make it bushy and compact. A full picking is usually obtained from the second to the fifth years, after which the old plants should be cleared off and burnt and the ashes spread over the ground. The land should then be ploughed, manured, cross-ploughed, and left fallow until the following spring, when re-stocking can commence.

The harvest is more or less dependent upon the season, but as a rule it begins in the first week of August, though if the weather is wet it is best to delay the cutting of the flowers until later. The best oil is obtained after a hot, dry season. The flowers should be fully open when cut, and if required for distillation they should be spread out on the shelves or on the floors of dry sheds until partially dry, when they are ready for dispatch to the distillers. If required for sale in bunches for market, they can be bunched and sent straight away after cutting; this is also done sometimes when the produce is to be distilled.

It is estimated that about 1,200 lb. of partially dried flowers, yielding 25 lb. of oil, is obtained from an acre of good land under favourable conditions. Much, of course, depends on the energy and careful superintendence of the grower, and also on the care taken by the distiller in the process of distillation. Last year distillers paid £40 to £100 per ton for flowers, according to quality. For bunched lavender the prices on Covent Garden market have been remunerative for the last three years, but the demand is said to vary considerably, so that the business is somewhat precarious. Last year prices varied from 18s. to 24s. per dozen bunches of 200 flower stems each, and from 6s. to

12s. per dozen bunches of 50 stems each, according to quality, though higher prices were sometimes obtained for exceptionally fine produce.

* * * * * *

Simple Method of Bottling Vegetables.

FAR greater attention is given to fruit bottling as compared with the bottling of vegetables. In certain cases, however, especially where green peas are available for the purpose, or green vegetables are not plentiful during winter, vegetables may usefully be preserved. The following notes on a simple method of bottling vegetables may be of interest in this connection:—

1. Choose young fresh vegetables. Grade for size and colour. Wash and prepare as for cooking, *i.e.*, scrape carrots and celery, peel turnips, etc. Keep white vegetables under water as much as possible to preserve the colour.

2. Plunge the prepared vegetables into a saucepan of fast boiling salted water (one teaspoonful of salt to one quart of water). Bring water again quickly to the boil, and allow the vegetables to remain from one to five minutes according to the nature of the vegetable, *e.g.*, peas and delicate vegetables one minute, vegetables of hard texture three to five minutes. Remove the vegetables and place them into a large basin of cold water to check the cooking and to make them firm. Leave them in this until cold (five to ten minutes).

3. Pack the vegetables as tightly as possible into vacuum bottles. Place one teaspoonful of salt on the top of each bottle.

4. Fill the bottles to overflowing with cold water. Place on the rubber ring, glass cap and screw band or clip. Screw up and then release slightly to allow air to escape during sterilisation. Place the bottles in a saucepan with a false bottom. Cover the bottles with cold water. Bring to boiling point in half-an-hour. *Boil gently for two hours.*

5. Lift out one bottle at a time and screw it down tightly before removing the next. When cold, remove screws or clips, and test lids to see if they are firm.

* * * * * *

Sheep Scab: Its Cure and Prevention.

THE most effective remedy for Sheep-Scab is dipping, provided that the dip used is one that has been approved by the Ministry of Agriculture, and care is taken to see that the dipping is thoroughly carried out in accordance with the instructions on the label.

The Ministry of Agriculture makes a special appeal to sheep-owners for their co-operation to see that

dipping is properly carried out; otherwise Scab can never be eradicated.

When dipping to comply with Orders of the Ministry of Agriculture or Regulations of the Local Authority, it is of the utmost importance to remember that:—

(1) the dip used must be one that has been approved by the Ministry of Agriculture. *There are a large number of effective dips for scab, non-poisonous as well as poisonous, which have been so approved and the responsibility in selecting an approved dip rests with sheep-owners,*

(2) the dipping bath must be mixed in the proportions specified as approved by the Ministry. It is inadvisable to make up a dipping bath by mixing two or more dips together, as this may result in neutralising the effect of both dips for scab, and may in some cases be injurious to the sheep,

(3) the directions and precautions indicated by the manufacturer on the label must be strictly observed,

(4) the sheep must be kept immersed in the bath for the period mentioned on the label. Special attention should be paid to the heads, necks and tails,

(5) during the dipping operations proportionate quantities of dip and water must be added to keep the bath up to proper strength,

(6) after each lot of sheep have been dipped and before the bath is re-mixed the dipping bath should be carefully cleaned out, the residue being disposed of in such a manner that it cannot injure animals or pollute streams. A satisfactory method is to run the residue from the bath into a trench or pit, the sides and bottom of which have been plentifully sprinkled with lime, so that the liquid from the bath runs through the lime before passing into the soil. *This is specially important when poisonous dips are used in order to avoid risk of injury to sheep through accumulation of poisonous matter.* Under no circumstances, however, should the lime be added to the liquid while it is still in the bath.

(7) If Arsenical Dips are used, the second dipping should be at half the strength of the first dipping, when two dippings are required, with an interval of not more than 14 days between them.

Persons using poisonous dips must take the precautions necessary for the avoidance of accidents or injury to sheep through the use of such dips. and the Ministry will not entertain any claim for compensation for injury or loss due to their use. The choice of an approved dip rests entirely with the user. The responsibility for the class of ingredients is a matter for the manufacturer of the dip. The approval of the Ministry only means that the ingredients of a dip are effective for Scab in the proportions approved.

WARNING.—All persons having or having had under their charge a sheep affected with, or suspected of, Sheep-Scab, are required by Law to give notice to the Police with all practicable speed. Persons failing to do so are liable to heavy fines, and in certain circumstances to imprisonment.

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Imperial Fruit Exhibition.

THIS Exhibition will be held at the Crystal Palace from 28th October to 5th November. The competitive classes are arranged in eight sections as follows:—

1. Amateur Section; organised by the Royal Horticultural Society.
2. Cider-Fruit Section; organised by the National Fruit and Cider Institute, and the National Association of Cider Makers.
3. Kent Commercial Section; organised by the Executive Committee of the Kent Commercial Fruit Show.
4. Eastern Counties Commercial Section; organised by the Executive Committee of the Eastern Counties Commercial Fruit Show.
5. West Midlands Commercial Section; organised by the Executive Committee of the West Midlands Commercial Fruit Show.
6. Overseas Section; organised by the Canadian Fruit Trade Commissioner in England.
7. United Kingdom Section.
8. British Empire Section.

The classes in Section 7 are open, without additional entrance fees, to all commercial growers of apples in the United Kingdom who have exhibited in either of Sections 4, 5 and 6. Those in Section 8 are open to all commercial growers of apples, or Associations of such growers, in the British Empire, and it is anticipated that the competition between home grown and imported fruit will be exceptionally keen.

It is hoped to arrange for non-competitive exhibits of an attractive and instructive nature.

The exhibition is organised and financed by the *Daily Mail*, and the technical details have been settled by an Advisory Committee convened by the Ministry of Agriculture. Further information can be obtained from the Organising Secretary, Imperial Fruit Exhibition, 130, Fleet Street, E.C.

Rabies.—*Middlesex (Acton District).*—All restrictions imposed in connection with the outbreak at Acton on the 8th December last were withdrawn as from the 30th June.

Berkshire District.—There have been no developments in this area, and providing no further outbreaks occur in the district, it is hoped to withdraw all restrictions from this district about the end of September next.

Wiltshire District.—A considerable modification of the restrictions has been made as from the 1st July by the exclusion of the portions of Dorset and Somerset which were subject to muzzling restrictions, and by the exclusion of portions of the Counties of Wiltshire and Southampton. As a result of this

modification the restrictions now apply to two districts; one lying wholly in the Counties of Southampton and Wiltshire, which includes inner controlled areas subject to special restrictions surrounding Salisbury and Southampton, and the other a small area in Wiltshire and Berkshire immediately to the south of Swindon.

One case of Rabies has been confirmed since those referred to in the July issue of the *Journal*, namely, on 5th July, at Southampton, in a dog which died on 4th June.

Foot-and-Mouth Disease.—Orders have been issued by the Ministry withdrawing all restrictions as from 4th July, on the movement and marketing of animals which were imposed in connection with the recent outbreaks of Foot-and-Mouth Disease in the North Midlands and in Yorkshire. No outbreak of the disease has occurred in any part of Great Britain since 7th June last.

Ireland.—An order has also been issued withdrawing all special restrictions as from 6th July on the importation of Irish animals, which were imposed on account of outbreaks of Foot-and-Mouth Disease in Ireland. From this date, therefore, the trade in Irish animals was resumed subject to the normal condition of 10 hours' detention in the landing place. Intending importers should, however, ascertain beforehand whether the Local Authority of their district have regulations in force prohibiting or restricting the movement of animals into their district.

Liming.—With reference to the article on "Liming" which appeared in the July issue of this *Journal*, p. 341, Mr. J. J. Griffith, B.Sc., wishes to point out two errors which inadvertently occurred:—

P. 344, last paragraph. 1·25 per cent. of calcium carbonate should read "0·125 per cent. of calcium carbonate."

P. 348 footnote, 1 per cent. lime requirement, &c., should read "0·1 per cent. lime requirement," &c.

Leaflets issued by the Ministry.—Since the date of the list given on page 384 of the July issue of this *Journal* three new leaflets have been issued and circulated:—

No. 374.—Hints on Egg Production.
,, 375.—Hints on the Production of Table Poultry.
,, 376.—Hints on Rabbit Keeping.

The following leaflets have been revised and brought up to date:—

No. 27.—Remission of Tithe Rent charge.
,, 146.—The Value of Records of the Milk Yield of Cows.
,, 191.—Coltsfoot.

The following leaflets have been re-written:—

No. 2.—Wingless Weevils.
,, 24.—The Gout Fly.
,, 245.—Crown Gall.

The following leaflets have been withdrawn from circulation:—

No. 64.—White Root Rot.
,, 209.—Gooseberry "Cluster-Cup" Disease.
,, 225.—The Septoria Disease of Tomatoes.
,, 272.—Supply of Store Cattle and Slaughter of Young Calves.
,, 310.—Poultry on Allotments and Small Garden Plots.
F.P. 11.—Hints on Purchasing and Using "Seed Potatoes."
,, 60.—Dung Heaps and the Preservation of Farmyard Manure.

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Andrew, R. C.—A Farmer's Handbook : A Manual for Students and Beginners. (126 pp.) London : G. Bell & Sons, Ltd., 1920, 6s. net. [63(022) ; 63.17(02).]

Pawson, H. C.—The Study of Agriculture : Hints for Students. (111 pp.) London : Vinton & Co., 1921, 5s. [37(02).]

Doyle, K. D.—Agriculture and Irrigation in Continental and Tropical Climates. (268 pp.) London : Constable, 1921, 19s. [63(024) ; 63.13.]

Malden, W. J.—Physical Culture in Farm Work (92 pp.) London : Wyman, 1921, 5s. [331 ; 371.]

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Emerson, F. V.—Agricultural Geology. (319 pp.) New York : J. Wiley & Sons ; London . Chapman & Hall, 1920, 16s. 6d. net. [55.]

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Taylor, H.—Farm and Estate Book-Keeping. (3rd Edn.) (285 pp.) London : Simpkin, Marshall & Co., Ltd., 1920, 6s. 6d. net. [657.]

Field Crops.

University of Leeds and Yorkshire Council for Agricultural Education.—No. 116 :—Report on a Test of Varieties of Wheat, 1920, at Manor Farm, Garforth. (15 pp.) Leeds, 1920 [63.311(04).]

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Horticulture.

Cecil, The Hon. Mrs. Evelyn.—A History of Gardening in England. (3rd Edition.) (393 pp.) London : John Murray, 1910, 18s. net. [63.5(42).]

University College of N. Wales, Bangor Department of Agriculture.—Varieties of Potatoes immune to Wart Disease. (11 pp.) Bangor, 1920. [63.512-194.]

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Live Stock.

Wilson, James.—The Breeding and Feeding of Farm Stock. (152 pp.) London: Methuen & Co., 1921, 6s. net. [63.603; 63.604.]

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Walker-Tisdale, C. W.—Milk Testing. (87 pp.) London: J. North, "Dairy World" Office, 1920, 3s. 6d. net. [543.2.]

University of Leeds and Yorkshire Council for Agricultural Education.—No. 119:—Factors influencing the Cost of Production of Milk. (46 pp.) Leeds, 1921, 6d. [63.714.]

National Physical Laboratory, Metrology Department.—Tests on Volumetric Glassware used in Dairy Chemistry. (14 pp. + 5 illus.) April, 1921. Single copies free of charge on application to The Director. Metrology (Glass Testing) Dept., The National Physical Laboratory, Teddington, Middlesex. Additional copies 6d. each, plus postage

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U.S. Department of Agriculture.—Farmers' Bull. 1115:—Selection and Preparation of Fowls for Exhibition. (10 pp.) Washington, 1920. [63.651(04).]

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 6.

SEPTEMBER, 1921.

NOTES FOR THE MONTH.

Corn Production Acts (Repeal) Act, 1921.

THIS Act has now received the Royal Assent and comes into operation on 1st October, 1921. The main provisions of the Bill as it then was were summarised in this *Journal* for August last (p. 385); certain changes were subsequently made but these have mainly related to Section 4. A memorandum explaining the provisions of this section as regards the formation of Conciliation Committees in Agriculture appears on p. 488 of this issue.

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Wheat and Oats (Payment Claims).

ON the 8th August, 1921, Sir F. Hall asked the Minister of Agriculture in the House of Commons what steps were taken by his Department to notify the growers of wheat and oats of their right to claim the payments provided for under Clause 2 of the Corn Production Acts (Repeal) Bill; what period was allowed during which claims might be made; and what action he proposes to take in regard to claims sent in after the expiration of that period?

In reply Lieut.-Col. The Rt. Hon. Sir Arthur Griffith-Boscawen, Minister of Agriculture, said " that very wide publicity was given to the requirements with regard to claims in respect of the minimum prices of wheat and oats under the Corn Production Acts. A form of claim was sent at the end of May or beginning of June to every occupier of an agricultural holding exceeding one acre, and notices explaining the contents of the form and emphasising the importance of the claim being made before the 30th June were issued to London and provincial newspapers to the number of about 750 on the 21st May, 18th June, and 25th June. On the 21st June, moreover, a special notice was issued with a covering memorandum to editors of newspapers, asking them to give it prominence. In deference to representations which were made that many growers of wheat and oats were unable to complete their claims by the 30th June,

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it was decided that claims might be made up to and including the 18th July, and a notice to this effect was issued on the 28th June, in which growers were warned that no further extension of time would be granted. In addition to the notices issued to the Press, notices were also published in the April, May, and June issues of the *Journal* of the Ministry.

It was necessary that a final date for the receipt of claims should be fixed, in order that they may be examined by the county committees as far as possible before the land is ploughed up, and, in view of the long period allowed in which to make a claim, I feel that farmers who failed to send in their claims by the prescribed date have no legitimate grievance. I do not propose, therefore, to accept claims made after 18th July, except where the occupier entered into occupation of the land after the 30th June."

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The Production of Artificial Farmyard Manure.

IN the last number of the *Journal* (p. 398), there appeared an article on this subject which deserves the attention of practical agriculturists. The results obtained constitute one of the most notable advances in knowledge of the principles of agricultural practice that have been made in recent years.

Interesting as the subject of "artificial" farmyard manure must be—especially for the market gardener—the advance in knowledge regarding the principles which underlie farm practice in relation to ordinary yard manure is equally noteworthy. It is now made clear that Nature, if left to herself, turns out a product which is practically of constant fertilising value. The making of dung is essentially a process for rotting straw. The latest advance of science confirms the wisdom of age-long practice—the addition of animal urine is the best way of rotting straw and producing the most essential of all fertilising agents. So much for theory, what of practice?

The discoveries that have been made establish, first of all, that under *ordinary* conditions of making and application it makes little difference whether dung is made from "cake fed" animals or not. A certain quantity of straw will give a certain amount of dung of a uniform fertilising value, and, secondly, if, as a result of feeding cake, the animals produce a richer urine, the best way of retaining the added richness during the period that ordinarily elapses between making (*i.e.*, thorough rotting) and application, is to *use more straw in the litter*. Unless this is done the additional fertilising value (nitrogen) may be lost in the air.

In fact, it would seem to follow that there is no necessary connection between the richness of the food consumed by farm stock and the value of the resulting dung as a fertiliser after storage for several months in the manner usually practised, *unless an adequate quantity of straw has been supplied as litter.* That is to say, the more or richer the food used, the greater must be the amount of straw used as litter, otherwise the increased fertilising value of the excrement is likely to be lost. If further investigation confirms this view, existing practice relating to farm valuations may have to be modified.

Next, the discoveries made by Messrs. Hutchinson and Richards point to a method whereby the ever-increasing shortage of farmyard manure may possibly be met. They have shown how it is possible to produce from straw a material which has the appearance and most of the properties of the natural product. Their investigations render the process an orderly one; the quantities of the various materials to be used, and the conditions under which successful results will be obtained, are laid down precisely.

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Preliminary Estimates of Acreage under Crops and Number of Live Stock.

THE preliminary statement of Acreage under Crops and Number of Live Stock in England and Wales was issued on the 8th August last and is printed on p. 572 of this issue.

The preliminary tabulation of the Agricultural Returns collected on the 4th June, 1921, in respect of agricultural holdings of over one acre in England and Wales shows that the total area under all crops and grass is 26,139,000 acres, a decrease since last year of 368,000 acres. On the other hand, the area of rough grazings (which comprises mountain, heath, moor, down and other rough land used for grazing) is now 4,555,000 acres, or 393,000 acres more than at the same date in 1920. Of the "farmed" area of 26,139,000 acres, arable land accounts for 11,618,000 acres and permanent grass for 14,521,000 acres.

The outstanding feature of the returns is a marked decline in the area of arable land, which, however, still remains the largest since 1905, excluding the years 1918-20 when the ploughed area was greatly increased as a result of the food production campaign. The majority of the crops contributed to the decline in the arable area, a noteworthy exception being wheat, the area of which shows a substantial increase. There are satisfactory increases in the case of each class of breeding stock (cows, heifers, ewes,

and sows) and in the total numbers of sheep and pigs, while there is a very marked improvement in the number of calves.

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Nauru Phosphate.

CONSIDERABLE interest has been aroused in the phosphates of Ocean and Nauru Islands. The phosphates produced in these Islands have since the War become Imperial property on the basis that the United Kingdom has a claim to 42 per cent. of the output at cost price, Australia to 42 per cent., and New Zealand to 16 per cent. The phosphates from the two Islands are almost identical in composition and origin, and have arisen from the interaction of the excreta of sea-birds with the coral rock of the Islands. While they cannot properly be described as guano, they have originated from guano, contain 85 to 89 per cent. of phosphate of lime calculated as tri-basic phosphate of lime, and are very free from iron and alumina. Both the physical and chemical character of the material is such as to render it readily soluble and available for growing crops

Owing to the shortage of high-grade basic slag, a shortage which is more pronounced because of the increased interest in the improvement of grass-land, the question of the availability of other phosphates is being closely considered. Many experiments show that finely-ground rock phosphates will do the work of the basic slag and encourage the growth of clovers in the same way, especially on old grass-land which is well provided with organic matter, and where the rainfall is abundant. Recent experiments in Essex, where the conditions are comparatively unfavourable, show that the action of rock phosphates compares favourably with that of basic slag. In America, the use of ground rock phosphates has become very general. Actual trials with these particular phosphates from the Pacific Islands have as yet only been reported from New Zealand, but there is every reason to suppose that they will be even more effective than the ordinary rock phosphates.

The control of the phosphates of Nauru and Ocean Islands has been vested in Commissioners, who have arranged with a Company to take the whole of the output allotted by the Commissioners to the United Kingdom. This Company has arranged to distribute it, mixed with basic slag in such a manner as to supply the farmer with grades of finely-ground material containing a minimum of 40 per cent. to a maximum of 65 per cent. of phosphates. When required it can be supplied free from admixture with basic slag, with a guarantee of 80 to 85 per cent. of phosphates.

The mixture supplies the farmer with a finely-ground material which will act as an effective fertiliser in practically all cases where basic slag is of value. Steps have been taken in the contract of sale to limit the profit which the manufacturer of this product can make, and the British farmer will obtain the advantage of getting the richest phosphate in the world at a price which represents only the cost of production and a reasonable profit to the grinder and distributor.

The Ministry of Agriculture has no hesitation in recommending farmers to try the mixture of the Nauru and Ocean Islands phosphate and slag for application to grass-land at the rate of 4 to 6 cwt. per acre according to grade, especially upon heavy soils, peaty soils, and all situations where the rainfall is not too light. On arable land, the mixture cannot always take the place of superphosphate for the turnip crop, but a dressing of 4 cwt. per acre will form a good basis of continuously acting phosphatic manure for the whole of the rotation. A further 2 cwt. per acre of superphosphate, drilled with the seed for the turnip crop, will give it that initial start for which superphosphate is so valuable.

As a means of establishing a stock of phosphates in the soil, the mixture is a cheap source of phosphoric acid. At current prices, it costs from 2s. 6d. to 3s. per unit of phosphate of lime delivered to the farmer's nearest station, whereas basic slag (30/32 per cent. total phosphate) costs 4s. 3d. or (20/22 per cent. total phosphate) 4s., and superphosphate (30 per cent. total phosphate) 4s. per unit. The mixture has the further advantage, from its richness, of reducing the charges for freight, carriage, cartage and handling on the farm.

Further experiments have been started to ascertain more accurately the applicability of the Nauru and Ocean Islands phosphate to particular soils and crops. Sufficient knowledge already exists, however, to enable the Ministry to recommend with confidence Nauru and Ocean Islands phosphate to the farmer who wishes to improve his grass-land and to lay a good manurial foundation for his arable land.

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Sale of Diseased Plants Order, 1921.

THE Sale of Diseased Plants Order, 1921, has recently been made by the Minister of Agriculture and Fisheries with the object of preventing the sale of diseased plants in England and Wales. It prohibits the sale of any plants or parts thereof which are substantially attacked by any of the pests named below:—

A. *Fruit and other Tree Pests.*

Fruit Tree Cankers (produced by *Nectria ditissima*, Tul., or any species of *Monilia*).

Silver Leaf (*Stereum purpureum*, Pers.).

Black Currant Mite (*Eriophyes ribis*, Nal.).

Woolly Aphis (*Eriosoma lanigerum*, Hausm.).

All Scale Insects (*Coccidæ*).

Brown Tail Moth (*Nygmia Phœorrhœa*, Dan.). (*Euproctis chrysorrhœa*).

Rhododendron Fly (*Leptobyrsa* (*Stephanitis*) *rhododendri*, Horv.).

B. *Vegetable and Root Pest.*

Potato Blackleg (*Bacillus atrosepticus*, Van Hall).

The sale of plants, &c., attacked by—

American Gooseberry Mildew (*Sphærotheca morsuvæ*, Berk.),

Wart Disease of Potatoes (*Synchytrium endobioticum*, Perc.), or

Onion and Leek Smut (*Urocystis cepulæ*, Frost),

is prohibited under previous Orders.

The Order comes into operation on 1st October, 1921. Further information may be obtained from the Ministry, Whitehall Place, London, S.W.1.

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The Sale of Seeds in Small Packets.

DURING the past season 1,534 packets of seed were drawn by the Ministry's Inspectors and forwarded to the Official Seed Testing Station for check tests to be carried out, as compared with 718 samples taken in the previous season. The results of the tests show a slight improvement on last year's figures, and may be summarised as follows (the figures are percentages):—

	Season 1919-20.	*Season 1920-21.*
Up to and above Standard of germination authorised by the Testing of Seeds Order, 1918	77·7	80·4
Below Standard but above two-thirds ...	14·9	13·2
Below two-thirds of the Standard ...	7 4	6·4

Under the Testing of Seeds Order it was not obligatory for the seller to declare the date on which the seeds were packeted, and the comparatively high percentage of packets containing seed of low germination may possibly be explained by the existence in the country of large stocks of packets of seed one year old or more. Under the Seeds Act, 1920, and the Regulations made thereunder, the vendor of packeted seeds may declare the neces-

sary particulars as to purity, germination, date of tests, etc., as prescribed for the particular kind of seed, or he may avail himself of the special provisions made for the sale of packets, in which case the date of the season in which the seeds were packeted must be declared. It is hoped that this practice will lead to the discontinuance of sale of old seed in packets.

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Departmental Committee on Allotments.

THE Minister of Agriculture and Fisheries and the Secretary for Scotland have appointed a Committee to investigate the present position as regards the provision by local authorities of allotments in Great Britain and to formulate recommendations for such amendments of the existing legislation and administration as may be desirable to secure adequate provision of allotments by such local authorities and to improve the tenure and security of occupiers of allotments.

The Committee will be constituted as follows :—

The Rt. Hon. the Earl of Ancaster, Parliamentary Secretary to the Ministry of Agriculture and Fisheries (Chairman).

Sir John Lorne Macleod, G.B.E., ex-Lord Provost of Edinburgh.

W. Bagshaw, Esq., O.B.E., Town Clerk of Doncaster.

Archibald W. Fisher, Esq., Secretary, Scottish National Union of Allotment Holders.

J. Forbes, Esq., General Secretary, National Union of Allotment Holders.

John Gilchrist, Esq., F.S.I., Bellshill, Lanarkshire.

Alderman G. A. Hemmings, Chairman of the Allotments Committee of the Swansea Borough Council.

D. A. Nicholl, Esq. M.A., LL.B., Town Clerk of Wandsworth.

George Nicholls, Esq., O.B.E., Director of the Small Holdings and Allotments Section, Agricultural Organisation Society.

Major W. G. Prescott, M.P. for North Tottenham.

G. I. Simey, Esq., Clerk to the Somerset County Council.

The Secretary of the Committee is Mr. E. Lawrence Mitchell (Ministry of Agriculture and Fisheries), to whom all communications should be addressed.

CONCILIATION COMMITTEES IN AGRICULTURE.

THE following Memorandum explains the provisions of Section 4 of the Corn Production Acts (Repeal) Act, 1921, but it is not in any sense a legal interpretation of its terms.

1. The Act cited above brings to an end as from 1st October, 1921, the Agricultural Wages Board and the District Wages Committees. In place of these, the Act provides for the formation of local joint Conciliation Committees in various areas for the purposes and with the powers described below, and the Minister of Agriculture is empowered by the Act to take such steps as he may think best calculated to secure the voluntary formation and continuance of the Conciliation Committees.

2. The Conciliation Committees will consist of representatives of employers and of workmen, and they will deal with rates of wages, hours of labour and conditions of employment.

3. Until a Conciliation Committee as above is formed in an area, the persons who on the date of the passing of the Act were representatives of employers and workmen (but not the appointed members) on the District Wages Committee for the area will be an Interim Conciliation Committee for any part of the area for which a Conciliation Committee has not been formed. No such Interim Committee may continue after two years from date of passing of Act.

4. Any vacancy occurring on an Interim Conciliation Committee will be filled by the Organisation by whom the vacating member was nominated, and until December 1st, 1921, any member of an Interim Conciliation Committee may be replaced by some other representative of the Organisation (either of employers or of workmen) by which he was nominated to the District Wages Committee.

5. The representatives of employers and workmen will respectively have one collective vote on any question. In other words, no resolution will be regarded as carried unless it has been approved by a majority of the members on each side.

6. A Conciliation Committee may appoint an independent Chairman. The Chairman so appointed may not be given power to vote except in respect to any particular matter as the Committee may determine.

7. It is contemplated that, by agreement, Conciliation Committees may be formed for smaller areas than those of the present District Wages Committee, and a Committee may make separate agreements for any part of the area for which it is formed.

8. Conciliation Committees constituted as above are empowered under the Act to deal with wages, hours of labour or conditions of employment in Agriculture in their respective areas. They may agree upon rates of wages for any class of person employed in the district or in any part of the district for which the Committee is formed, and may fix special rates of wages for special classes of workmen or may provide for the exemption, on account of special circumstances, of particular classes of workmen from the rates agreed upon.

9. When a Conciliation Committee has agreed upon a rate of wages, it may, if it so agrees, submit the agreement to the Minister of Agriculture for confirmation. The Minister may thereupon confirm the agreement, and cause it to be advertised in the district to which it applies, with particulars of the date from which, and the period for which, it is to operate.

10. A rate of wages having been agreed upon by a Conciliation Committee, and confirmed and advertised by the Minister of Agriculture, it becomes, for so long as the agreement is in operation, an implied term of every contract for the employment in the district of a workman of any class to which the agreement applies that the employer shall pay to that workman wages at not less than the rate payable under the agreement.

11. Nothing in any contract for the employment of a workman shall operate to deprive the workman of his right to receive wages at the rate agreed upon by the Conciliation Committee and duly confirmed and advertised except:—

(a) where the Conciliation Committee or a Sub-Committee thereof is satisfied that the contract for payment of wages at a lower rate is, having regard to any special circumstances affecting the workman or to the special terms of the contract, fair and reasonable, and issues a certificate accordingly; or

(b) where, on an application for such a certificate, the Committee or Sub-Committee has failed to agree with respect to the matter, and the Court in which proceedings are taken for the recovery of wages at the rate agreed by the Committee, is so satisfied as aforesaid;

and then only to the extent to which the Conciliation Committee or Sub-Committee certifies or the Court determines that the wages payable should be at some lower rate than the rate so agreed by the Committee.

12. Proceedings may be taken in a Court of law for the recovery of arrears of wages at the rate agreed by the Conciliation Committee. Such proceedings must be commenced within three

months after the date when the workman left the employment and a person will not be entitled to recover wages for more than three months or for such longer period not exceeding one year as the Court shall consider just.

13. For the purposes of this section of the Act, the expression "agriculture" includes dairy farming and the use of land as grazing, meadow or pasture land or orchard or osier land or for market gardens or nursery grounds, but not woodlands or woodland nurseries and the expression "agricultural" is to be construed accordingly. The expression "workmen" includes boys, women and girls. The expression "employment" means employment under a contract of service or apprenticeship, and the expressions "employ" and "employer" are to be construed accordingly.

In connection with the Conciliation Committees referred to above, the Minister has addressed the following letter, dated August 13th, 1921, to representative members of the existing District Wages Committees:—

Dear Sir,

You are doubtless already aware of the provisions of the Corn Production Acts (Repeal) Bill, which has now passed through all its stages in the House of Lords.

The effect of the Bill is to terminate the Agricultural Wages Board and the District Wages Committees, but the Minister of Agriculture is empowered to take such steps as he may consider best adapted for securing the establishment by agreement of Local Joint Conciliation Committees throughout England and Wales for the purpose of dealing with wages and hours of labour. I am very anxious that all the necessary preliminary arrangements for giving effect to the Act should be made without delay and with the fullest co-operation of all concerned, and as a first step I have felt it to be essential to acquaint you and all other representative members of the present District Wages Committees of the position.

Subject to the provisions of Clause 4 (2), it is provided by the Bill that the members of the District Wages Committee for a particular area, who at the date of the passing of the Act represent the employers and workpeople respectively (but not the appointed members) shall be a Joint Conciliation Committee for the time being until a permanent Conciliation Committee has been set up, and accordingly I have to ask whether you will be good enough to act as a member of the Interim Committee for

your area. As you are probably aware, the rates in operation under the Orders of the Agricultural Wages Board will, on the Bill becoming law, cease to have effect as statutory rates as from the 1st October next. In my view it is of the utmost importance that the representative members of the District Wages Committee should meet as an Interim Joint Conciliation Committee at the earliest possible date with a view to entering into an agreement as to the conditions that are to operate in their area as from the 1st October and for such period as may be agreed upon. In this connection the Committee is empowered under Clause 4 (3) of the Bill to make agreements for the whole or for any part of the area for which the Committee is at present acting. Having regard to the short time that is available between now and the 1st October, I need hardly urge upon you the importance, in the interests of the industry, of the Interim Joint Conciliation Committee making arrangements on the lines I have indicated above so that no difficulty may arise in the area owing to the cessation of the Wages Board. It will also be appreciated that a temporary arrangement of this kind will give time during which a permanent Committee can be set up, consideration given to the formation of new areas where necessary, and any other difficulties solved.

The Interim Joint Conciliation Committee will, in the circumstances of the case, start without a Secretary, and in order to assist the Committee I am giving instructions that the Secretary of the District Wages Committee shall place his services at the disposal of the Joint Conciliation Committee up to the 30th September or until arrangements have been made by the latter for carrying on the necessary secretarial work. The Secretary of the District Wages Committee is accordingly being requested to make the necessary arrangements for convening the first meeting of the Conciliation Committee at as early a date as possible, and he will send you a communication in due course.

I avail myself of this opportunity to express my thanks to you for the services you have rendered as a representative member of the District Wages Committee for your district, and I hope that you may be able to see your way to attend the meeting of the Interim Conciliation Committee which will shortly be called.

Yours faithfully,

ARTHUR G. BOSCAWEN.

THE NEW FARM INSTITUTES.

SIR DANIEL HALL, K.C.B., F.R.S.,
Chief Scientific Adviser, Ministry of Agriculture and Fisheries.

THE coming autumn will see a welcome increase in the number of Farm Institutes. The number of complete Institutes which were at work during the session which is just over was four, viz., the East Anglian Institute of Agriculture, Chelmsford (Essex County Council); Newton Rigg (Cumberland and Westmorland County Councils); Madryn (Carnarvonshire); and Sparsholt (Hants County Council). Instruction of a Farm Institute type was also given at the Monmouthshire Agricultural Institution at Usk. Seven new schemes should be completed in time to start work next month (October), bringing the total to twelve. Six of the new Institutes are being provided by County Councils:—Reaseheath (Cheshire); the Agricultural Institute, St. Albans (Herts); Moulton Grounds (Northants); Rodbaston (Staffs); Cannington Court (Somerset); and Llysfasi (Denbigh). One Institute (Little Chadacre, Suffolk), is a gift from Lord Iveagh, who has generously made himself responsible for the entire cost, initial and annual.

The position would have been still more favourable if it had not been for the Cabinet Veto on new Schemes relegating to abeyance six other schemes which could not be considered as "in operation" at the time the halt was called. It is hoped that the new fund, which will be established when Clause 3 of the Corn Production Acts (Repeal) Bill becomes law, will enable these schemes "in abeyance" and a further four or five new Schemes to be proceeded with.

It is thirteen years ago since the idea of Farm Institutes was originally put forward in the Report of the Departmental Committee on Agricultural Education, presided over by Lord Reay [Cd. 1206—1908]. The progress seems slow, but when allowance is made for the set-back caused by the War and its financial legacies the start that has been made is not unsatisfactory.

Winter Courses.—The Farm Institute is regarded by the Ministry as a most necessary agency for the instruction of the majority of future occupiers of the land, and the chief intelligence centre in each district to meet the current requirements of the industry for information and advice. From the educational side the Farm Institute is distinct from an Agricultural College in that it aims at giving instruction by means of short winter courses which will not involve any long absence of the student from the farm. As a rule a course of instruction is covered

by two terms of about twelve weeks each, before and after the New Year, which may be taken consecutively or with a year's interval between the first and second. Probably, a third term would cover the subject more adequately, and the ideal system might well be one under which a student left his farm and spent one term at the Institute in each of three consecutive years, thus maintaining the educational stimulus over a considerable portion of the formative part of his life. It is realised, however, that any arrangement of this kind would be hard to reconcile, on administrative grounds, with the necessity for keeping the accommodation filled and so ensuring that the fixed overhead charges are spread over as large a number of students as possible. Until the Institutes have grown sufficiently to permit of other organisation, the normal course will probably consist of two, or in some cases three, consecutive terms.

As the instruction given by a Farm Institute takes place in the winter months, and as it is intended for young people coming from farms, it should not be thought of as providing a complete training in manual operations, or what is sometimes called practical work upon a farm. Most of the Institutes have farms of considerable size attached to them, and students will be required to take part, under supervision, in seasonal practical work on the farm, with the stock, or in the dairy, gardens, etc. Participation in such practical work will, however, be for the purpose of illustrating the general principles taught in the class-room and the laboratory, and not for the purpose of turning out a skilled manual worker. The student should obtain his practice in actual farm operations upon his home farm; the object of the Institute course is to awaken a student's intelligence with regard to those operations and provide him with the kind of information that he cannot get by following the routine of any single farm. For example, the Institute courses would treat of methods of cultivation and rotations from the point of view of results and costs, with the choice of seed and new varieties, and with the varieties of fodder crops to suit particular soils and systems of farming. The student would be taught the functions of different fertilisers, their selection and purchase, and the meaning of an analysis. Similarly, the choice and purchase of feeding stuffs, and the main principles of feeding and breeding would be treated. Above all, he should early be introduced to the meaning and value of farm book-keeping, and to the necessity of checking the operations of farming by costs. The Institute farm would not be used for direct teaching, but its records would provide a basis for much of the instruction on management.

Summer Courses.—Having devoted the winter months to the education of farmer's sons, and incidentally of a few women who wished to farm on their own account, the Farm Institute should provide a third course of three or four months' duration in the summer for the instruction of the farmer's wife or daughter. The object of the course should be to render the woman student an efficient partner in the management of a small farm. The course of instruction on the agricultural side would deal with the care of live stock, especially dairy cows, poultry and pigs, and with the management of a dairy and garden. The domestic side of the course should include the preservation of foodstuffs, *e.g.*, jam-making, fruit-bottling, bacon-curing, cooking and housewifery generally—whatever is necessary to make the woman an efficient participator in the economy of a farm. It should not aim at teaching women to farm; those who so desire should share in the men's course of instruction.

General Assistance and Advice.—While the Farm Institute should thus be the centre for instruction by means of short courses, it should also become the permanent place of assembly of the various instructors working in the county area. Farmers should be encouraged to call there and bring their difficulties; special lectures and discussions for farmers should be held, and old students led to form the habit of turning to the Institute for advice. The farm with which an Institute should properly be equipped, while providing material for teaching as indicated above, should also be a centre for more permanent experiments and demonstrations than can usually be carried out co-operatively with farmers in the area. For example farmers ought always to be able to see trials of the newer varieties of cereals and other farm crops.

The Somerset County Council's Institute at Cannington Court was described in the March, 1920, issue of this *Journal*, and an article describing the Staffordshire County Council's Farm Institute at Rodbaston is printed at p. 495 of this issue.

A preliminary notice regarding Farm Institute courses which will commence in the ensuing autumn has been printed separately and is obtainable on demand. As the new Institutes provide additional residential accommodation for only some 150 to 175 students, and as the flow of students to all kinds of educational institutions, including those of agricultural education, shows little signs of abating, it is very desirable that early application should be made by all who wish to avail themselves of the facilities provided at Farm Institutes.

THE STAFFORDSHIRE FARM INSTITUTE, RODBASTON.

J. C. RUSHTON, F.H.A.S.,
Principal of the Farm Institute, and Assistant Director for Agricultural Education, Staffordshire County Council.

THE Staffordshire County Council propose to open the Rodbaston Farm Institute for the reception of pupils early in October. The estate, which comprises 583 acres, was purchased early in the year 1919. A portion, 268 acres, has been utilised for a small-holdings colony, and the remainder has been retained for educational purposes. There are on the farm extensive farm buildings, a bailiff's house, and a large mansion containing upwards of thirty rooms. There is an extensive walled garden which contains large glass houses.

From an historical point of view the estate is of interest. The name "Rodbaston" is of considerable antiquity. It figures in the Domesday Survey, made in the year 1086, as the manor of Redbaldstone, County of Stafford. At that time it was the property of Richard the Forester, otherwise known as Richard the Hunter, and was conferred upon him by favour of William the Conqueror in return for his services as keeper of the then existing and adjacent forest of Kanoc (Cannock). The mound on which the original house was built is still to be seen surrounded by an ancient moat.

The Institute is situated in the Parish of Gailey, eight miles from the county town of Stafford, and an equal distance from the busy manufacturing town of Wolverhampton.

Owing to the need for economy the original scheme has been greatly modified. For the present, temporary dairy accommodation has been provided, and a house for the Principal is in course of erection. Arrangements have been made in the hostel for classrooms and a laboratory. At the farm buildings there are a carpenter's and a blacksmith's shop.

When certain alterations have been made in the house there will be accommodation for the residence of the staff and for twenty-five students.

The course of instruction for male students is intended to extend over two terms, each of eleven weeks, from October to March, and it is proposed to provide a summer course for women students from April to July.

The chief aim of the instruction given will be to prepare young men and women for the daily routine work on the farm

or in the farmhouse. With this object in view the lectures in the classroom will be co-ordinated with the practical work of the farm, and of the dairy and kitchen. Throughout the course a large proportion of the time will be occupied in ordinary practical operations affecting each subject of instruction, and every student must be prepared to take his part in the work. The instruction given at the Institute is specially designed for those who intend to obtain their living from the land. For example, the lectures on "Breeds and management of cattle, horses, sheep and pigs" will be followed by practical instruction in stock-judging, where the score card will be used and the chief points of the various breeds and classes of farm animals will be illustrated. The cultivation and improvement of land, the handling of labour, demonstrations of the use of manures, the results obtained from the use of various feeding stuffs, the increase in the live-weight of cattle, sheep and pigs as shown by the weighbridge, will be practically demonstrated.

In the garden the management of fruit and vegetable crops for home consumption and for market-gardening purposes will be practised. The keeping of poultry and bees will also be taught by the most up-to-date and practical methods.

The fees for the six months' winter course will be as follows:—

Tuition fee for all students	£5.
Maintenance fee for pupils resident in the Administrative County of Stafford	£25.
Maintenance fee for pupils residing outside the Administrative County of Stafford	£45.
Maintenance fee for day pupils	£7 10s.

A limited number of Scholarships and Maintenance Grants will be offered to selected students who are resident in the Administrative County.

The most promising students will be encouraged to proceed from the Institute to the Provincial Agricultural College (Harper-Adams Agricultural College, Newport, Salop), or to the University, and those from the Administrative County will be eligible to compete for the Major Agricultural Scholarships.

The course for women students will provide instruction in dairying (including cheese-making and butter-making), poultry- and bee-keeping, fruit and vegetable growing, and domestic science and household management.

In all cases continuity will be the aim of the Institute, which will form a step in the ladder leading from the elementary school to the Agricultural College or to the University.

AGRICULTURAL RESEARCH AS A CAREER.

The progress of agricultural science has in the past been hampered by the poor material prospects which agricultural research work has offered to the scientific worker. To attract and retain talented workers in this sphere the Ministry has instituted a scheme which affords a definite career to the men and women engaged at the Agricultural Research Institutes in England and Wales. Before proceeding to describe the scheme, however, it may be explained that these institutes are for the most part attached to a university or university college, the notable exception being the Rothamsted Experimental Station at Harpenden, which is at the same time the oldest and one of the largest and most important. Each institute devotes itself to a particular branch of agricultural science, as for example, plant nutrition and plant pathology at Rothamsted, plant breeding and animal nutrition at Cambridge, agricultural economics at Oxford, fruit culture at Long Ashton and East Malling. The members of the scientific staff are recruited principally from young graduates who have taken honours in natural science and who have since specialised in some branch of science with an agricultural bearing, frequently with the aid of a research scholarship granted by the Ministry.

Each institute is independent and self-governing, but certain grades of staff have been established common to all, and it is expected that there will be promotion, not only within institutes, but from one institute to another concerned with similar branches of science. At each institute there is a Director who receives a personal salary; below the grade of Director there are Principal Assistants with a salary of £600 rising by annual increments to £800 a year; Senior Assistants with a salary of £400 rising to £600; Assistants with a salary of £300 rising to £360; and temporary Junior Assistants with salaries varying according to their duties and the cost of living. A bonus, the amount of which is subject to revision from time to time as the cost of living falls, is at present paid to Assistants, Senior Assistants and Principal Assistants. At the moment of writing the bonus is £150 on salaries of £400 and under, and 15 per cent. on amounts over that sum; a reduction will, however, shortly be made in these rates.

The tenure of the posts of Principal and Senior Assistants may be regarded as possessing much the same measure of permanence

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as that of a Professor or Reader in a university. The establishment is guaranteed by the Ministry so long as Parliament continues to provide funds, and the occupier of the post may expect to hold it *quam bene*. The tenure of posts of Assistant is, however, not guaranteed, and appointments as Junior Assistant are in all cases temporary. With few exceptions a contributory superannuation scheme is in force at the Research Institutes, and every permanent worker may look forward to a moderate pension on retirement at the age of 60 or 65.

Research workers at Research Institutes are in no sense Civil Servants. The Ministry makes annually a contribution to the funds of each institute, but this is purely a grant-in-aid, so that, although the institute would in all probability be unable to carry on its work, at any rate on the same scale, if the Ministry's contributions were withdrawn, the final responsibility rests upon the university or other governing authority, and the strict liability of the Ministry ceases when its grant is paid. It is in the highest degree unlikely that Parliament would cease to vote money for the prosecution of research in agriculture or that support would cease to be given to Research Institutes: but the adoption of the system of annual grants-in-aid ensures (1) that the institute retains its power of self-government, and (2) that the work and administration of the institute must justify the support for which it asks. This method of control by grant-in-aid without direct administrative responsibility is, of course, a usual feature of the British system of administration. By applying the method to agricultural research it is hoped to combine the minimum of State interference with the most favourable conditions for carrying out research.

While it is theoretically possible to conduct research in a Government Department, it hardly admits of doubt that the atmosphere of the university is more conducive to good work.

"When one considers the nature of research, the slowness and irregularity with which results of visibly economic value accrue, the remoteness of its methods from those of a public department, and particularly the character and personality of the men who distinguish themselves in research, it will be generally agreed that the looser system of control prevailing in a university is the most appropriate. The true investigator is always somewhat anarchical in temperament, his work is apt to be continuously destructive of accepted opinions and established reputations. . . . The type of man wanted for research is more attracted to a university than to a Department. . . .

A second advantage which comes from the association of Research Institutes with the universities lies in the informal co-operation that is thereby ensured with other workers in the field of pure science. . . . Lastly, contact with the business of farming is more readily attained by the association of the Research Institute with a University which is teaching agriculture and dealing with the farmers of its district than with a Government Department."*

Parallel to the Research Institutes are the Advisory Centres. The Advisory Scheme is designed to place the services of specialists in various branches of agricultural science at the disposal of farmers in each of the "provinces" into which England and Wales have been divided for the purpose of agricultural education. There are advisers in botany and entomology who deal with the fungoid and insect pests which attack plants, in chemistry who deal mainly with soil questions; other advisers will be appointed for animal diseases which are not dealt with in ordinary veterinary practice. and possibly for other subjects. To be able to advise, these men must not only start with specialist knowledge but must be able to investigate the problems arising in the district which they serve. The considerations which have determined the placing of research in the hands of institutions of a university type have decided the Ministry to attach these advisers also to such institutions. The grades, salaries and general conditions of service are the same as those for research workers. The advisers have a somewhat closer bond, however, with the Ministry of Agriculture in that they may be called upon, for example, to take part in organised measures against some particular pest, and they submit to the Ministry periodical reports on plant diseases which are collated with those from other districts and other sources.

A word may be said finally on the Research Scholarships which are awarded by the Ministry, and which may be regarded as an avenue to a career of agricultural research. In the present year the maximum number of scholarships to be awarded is five. The candidates must have taken an honours degree in natural science or must produce other evidence of exceptional qualifications for an advanced course in some branch of agricultural research. The applications are considered by a committee upon which there sit leading men in agricultural science and certain public officials; upon the decision of this committee the awards are made. The scholarships are of the value of £200 a year, and

* Sir D. Hall: Trueman Wood Lecture, Royal Society of Arts, 1921.

the scholars are required to pursue a course (at present of two years' duration) at one or more approved institutions. Quarterly progress reports are submitted to the Ministry. No promise of employment is held out to scholars when their scholarship expires, but it is natural for the Directors of Research Institutes to look for their assistants from among them, providing that they possess the qualifications which are required for a vacant post or a particular piece of work.

The assistance which the Ministry gives does not end with scholarships, for it has been able recently to award, and hopes in future to offer annually, a small number of travelling fellowships to provide the expenses of research workers who desire to visit laboratories and other institutions abroad and to extend their knowledge of methods and technique.

The whole scheme is yet in its infancy, and it is too early to speak of more than the promise of success. To the country it promises a succession of able investigators making agricultural research their life work: to the worker it promises a career free, as far as is reasonably possible, from the distracting cares of an ill-paid profession: to the young graduate it promises a ladder, not to riches, but to the highest rewards of science, the discovery of truth, the advancement of the public good, and the esteem and appreciation, never unduly bestowed, of his fellow-workers.

THE HERDWICK SHEEP.

A. EWING REID, M.C., N.D.A., N.D.D.

THE Herdwick sheep is a breed of sheep little known beyond its native hills—the Fells of Cumberland, Westmorland and North Lancashire. The unique characteristics which eminently fit the breed for the poor high pastures are not those to commend it in the fatter lands and more populous places. The writer has never seen Herdwick sheep nor heard of their existing outside the counties of Cumberland, Westmorland and Lancashire, and in these counties they exist only on the Fells or hills.

The first volume of the Herdwick Sheep Breeders' Association published in 1920 registers flocks of breeding ewes to the number of 13,600, and there are many flocks not in the Herd Book. Though numerically comparing unfavourably with the other and better known breeds of sheep, they are nevertheless of great importance. In the writer's opinion they are the only breed of live stock capable of existing on and exploiting agriculturally that huge stretch of high-lying poor land which constitutes the picturesque mountains of the English Lake District.

The exceptional hardiness of the breed is evidenced by their habitat, some of the runs or heafs reaching more than 3,000 feet above sea level, *e.g.*, Helvellyn, Skiddaw, Saddleback. The sheep possess original characteristics and apparently have no affinity to any other British breed, though it has been suggested that they may have been the progenitors of the Black Faced Sheep. Attempts to cross them with other breeds to improve their wool or weight have without exception failed, their hardiness always being impaired.

The name Herdwick (*Herd*, a number of animals under charge of a man; and *wick*, a district or here a run) signifies a tract of land under charge of a herd or shepherd employed by the owner or Lord of the Manor.

The following extract is from a charter of lands at Furness Abbey, dated 1537, and brings out the meaning of the word Herdwick: "Pastures and Agistament and brusying occupied to those of the said late Monastery for the sustentacyon of the catell and . . . devyded into sundry herd wycks and shepe cots." Also, referring to lands in same district in 1564: "Those parcells following, that is to say the Herdwick called Waterside Parke—the Herdwick called Lawson Parke, &c."

The name of the breed is derived therefore from the peculiar custom associated with feudal grazing rights (and still seen in

the unique type of farm "let"—the general rule even to this day) and not from any place name or physical peculiarity of the sheep as with most other breeds.

Origin.—The origin of the breed is obscure. Local legend credits its origin to 40 small sheep washed ashore from a Spanish ship wrecked on the Cumberland coast at the time of the Armada, and which, becoming the property of the Lord of the Manor and being found to suit the high bare lands in the neighbourhood, were apportioned to local farmers. The mode of farm "let" still commonest, viz., that of a flock of sheep "the heaf going flock" being let along with the land lends some support to this legend. Careful investigation, howev. r, reveals the fact that a Spanish breed resembling Herdwicks in any character, did not then exist, and it is more likely that the breed is of Scandinavian origin, where hardiness would be a characteristic. The Herdwick country is rich in evidence of Norse occupation, "garths" and "holms" and "bys" predominating as place names. The theory of the Scandinavian origin is further substantiated by a method of scoring used among Herdwick men within the memory of man. The numbers used varied locally, but the following appears to have been the commonest:—

1. Yen.	6. Haata.	11. Yan a dick.	16. Yan a Mimph.
2. Taen.	7. Slaata.	12. Taen a dick.	17. Taen a Mimph.
3. Tedderte.	8. Loura.	13. Tedder a dick.	18. Tedder a Mimph.
4. Meddert.	9. Dowra.	14. Medder a dick.	19. Medder a Mimph.
5. Pimp.	10. Dick.	15. Mimph.	20. Gigget.

Description.—The Herdwick looks what it is, a hardy mountain sheep. The activity required to make a living on the snow-covered Fells, and a coat to withstand the rigours of those high altitudes in winter, indicates a smallish, active, rough-coated sheep. A touch of the demerits of its ancient lineage and a suggestion of the primitive are discernible.

The characteristics of a good Herdwick are a coat of long, well-knit broad wool grown well out at the extremities, standing up round the neck in a good mane, and covering the top of the head. The head should be carried high—the nose arched, and the eyes prominent and well developed. The face should be grey or rimy (hoar frost appearance). Spotted legs and faces are inadmissible, but dark coloured sheep generally show best constitution. The lambs are born a good black and white, the head, legs and neck being black, the rest of the body white. As they grow older the dark colour changes to a light grey. The ears are white, sharp and active. The body is round and deep, the chest wide and prominent. The legs are short from knee to

Photo] [*Mayson, Keswick.*

Herdwick Ram King Dick. Owner, F. R. Searle. Lonscale, Threlkeld

Photo] [*Mayson Keswick.*

Herdwick Ewes on Skiddaw Fell.

Photo] [*Mayson, Keswick*

Herdwick Ewes and Lambs on typical Fell

fetlock and covered with strong bristly hair, and the feet are wide and white. Especially in one flock the presence of an extra or 14th rib is often found.

The rams are generally horned; of 570 examined, only $4\frac{1}{2}$ per cent. were hornless, and some of these latter had rudimentary horns. The ewes are always hornless.

The Fells, the habitat of this breed, are high up, 3,000 feet or more, steep, hard, dry, and poor grazing On these Fells perhaps no other breed of British live stock could exist, yet except when the snow is too deep or is frozen for a lengthy period the Herdwicks receive no hand feeding. The winter death rate is high, but only the existence of such a breed allows those poor heights to be exploited. Bracken covers the Fells, and maggots are a serious summer cause of wastage.

A Typical Tenancy.—Some of the Fells have recently been fenced, but generally the Herdwick farm is unfenced, the grazing rights being described in the lease as "unlimited Fell." This fact dictates, though the Feudal system may have had its influence, the unique custom, still the general rule, that a regular breeding flock of sheep, the "heaf (heath) going flock" is let along with the land. The flock, like the land, is the property of the landlord. The tenant finds security for redelivery of this flock at the end of the tenancy. The let stipulates that "the heaf going must be maintained," and a like number of sheep of condition, quality, age and sex be handed over to the incoming tenant. Oversmen act for both parties at the turnover, and the landlord may pay for "betterment" or the tenant for "worsement."

A typical heaf going flock would consist of the following sheep, as in a place which was advertised last year:—

200 Wethers: 80 4-year-old, 120 3-year-old.
300 Ewes.
250 Hoggs, half male, half female.
150 Twinters, *i.e.*, two winters, half male, half female.
3 Rams.

Total 903 Sheep.

Heaf going flocks vary from 50 to 2,000 sheep. The 69 flocks registered last year in the Herdwick Sheep Breeders' Association Flock Book shows an average ewe stock of 169 ewes. These represent the hill farms, but many much smaller flocks are kept as part of the smaller stock raising hillside farms.

Especially on the fenced places the custom is growing of keeping all "gimmer," *i.e.*, female hoggs.

On these unfenced Fells, it is only by keeping sheep reared on the place that straying can be prevented, and the full resources of the Fell can be exploited. The older sheep lead the others well out towards the boundaries. For these reasons wethers are kept to the age of four or five years, a custom now considered elsewhere unsound economically.

The fact that these flocks can be maintained on unfenced lands is entirely due to the quite exceptional homing instinct of the Herdwick sheep. A Herdwick born on a particular place will spend the rest of its life within a few hundred yards of that place, and a shepherd knows where he will always find particular sheep. Herdwicks sold away from their native heafs will return from incredible distances, crossing rivers and even lakes en route. To-day they are brought from 3 to 7 miles for dipping, &c., through the flocks of several owners. On being released, if unrestrained, they return to their own heafs.

The rams are put out on the Fells from Martinmas to the end of November. In the higher places they are "ruddled," *i.e.*, coloured all over with red so that they may be easily seen by the ewes on the open Fells during snow. At the autumn shows at Eskdale and Keswick, the rams are generally shown "ruddled."

The peculiar custom of "Ram Letting" is general, and at Keswick on the first Saturday in October and at Eskdale on the last Friday in September large numbers of rams and ram lambs are exposed for sale or hire. The writer knows one farmer who at present keeps seventy stock rams. Many of the best rams are bespoke for years in advance. The hiring fee varies from 30s. to £5 or more—one famous ram was let for seven days at £1 a day, and another for 10 days for £7. Ram lambs are let out to farmers to winter—the farmer wintering them, then having the option of claiming their use for two or more years free of charge

In the cold spring weather after the season, the rams are kept inside, hand fed and turned out to water, and some of the smaller flocks are housed this way in winter and hand fed. Up to £50 has been paid in the open market for a Herdwick ram.

The lambs are dropped not before the end of April; 90 lambs to 100 ewes is good, 80 to 100 not bad; 10 per cent. of ewes with twins is quite good.

It is essential that the lambs be wintered on low land the first year. The usual Herdwick farm not having sufficient low land for this nor to grow hay to hand feed them, wintering "outside" must be found. Owing to the difficulty of finding this near, to the high cost of freightage if carried to a distance, and

to the high charge for wintering (now 12s. 6d. a head from 10th October to Ladyday) this unfortunately essential charge is a very serious drain on the hill farmer.

As the majority of the farms are unfenced it is especially necessary that the sheep of each flock can be easily identified. Each flock therefore has its characteristic ear and body marks. These are registered in the Shepherds' Guide, where engravings of both sides of the sheep of each flock are given, showing the position and description of the various marks. Marks have become part and parcel of certain places, remaining with them through any changes of tenancy, *e.g.*, just a raven clapped on the near side will always mean Ravenscrag farm. Flockmasters were wont to meet annually at Kerkstone Top (2,000 ft.) to exchange strays, but this is now done mostly at the various sheep fairs and ram hirings.

The best ewes are generally kept for the production of pure bred lambs, but on those places where any low land is available a proportion of ewes will be crossed with Leicester or Wensleydale rams for producing grey-faced lambs. The former give the quicker-growing lambs, the latter the longer-backed selling sorts. These grey-faced lambs are sold to the lowland farmers who fatten them off or keep them as breeding stock.

The average weight of the dressed Herdwick carcass is about 12 lb. per quarter for adults. The mutton is unexcelled by that of any British breed of sheep, and 4-year-old Herdwick mutton is claimed to be the best finished and most valuable mutton produced. Four-year-old Herdwick wethers sold last year at prices ranging to over £5 each.

The average ewe fleece weighs about 4½ lb., but rams and ewes fed for shows often yield twice that weight. The wool is coarse, and was used for carpet making, but at present, like the wool of other breeds, it is a drug on the market. In 1908 the price fell as low as 4d. per lb.

Among these mountains innovations come slowly and many ancient and interesting customs still survive. The Shepherds' Meets, at which formerly "strays" were handed over, partake now more of the holiday, and at the Dun Cow at Mardale (soon to be 20 feet below the surface of Lake Haweswater) there is annually a great meeting of shepherds; the day is given over to fox hunts, hound trails and Fell races, the evening to song and sentiment, where yet one may hear many a lusty hunting song and many a strange toast—such as "Confusion to the scab," and "Full sheets and ready money."

SILAGE FOR DAIRY COWS.

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IN the eastern parts of Essex, Suffolk and Norfolk considerable difficulty is experienced in growing satisfactory crops of mangolds owing to the dry climatic conditions prevailing during the summer months, and in the case of Essex these unfavourable circumstances are accentuated by the very heavy nature of the London clay soils.

It is because of these difficulties that many farmers have been turning their attention to silage as a substitute for roots.

In an average season silage cannot be grown at the same cost per ton as roots, and it is probable that unless it can perform other feeding functions than replace an equal weight of mangolds it is not likely to prove an economical substitute for roots in the feeding of dairy cows.

In an article in an earlier issue of this *Journal* (Vol. 23, June, 1916, p. 224) Oldershaw gave an account of some trials he made to ascertain whether a ration of 60 lb. of silage could replace 60 lb. of mangolds and 7 lb. of straw chaff in the feeding of dairy cows. The silage used consisted of tares and oats in the proportion of 1 of oats to 2 of tares, and the results showed that for milk production the silage ration was slightly superior; the difference, however, was so small as to be within the limits of experimental error.

An examination of the rations shows, however, that the silage ration contained considerably more albuminoids than the mangold ration, and it would therefore seem that use could be made of this fact to reduce considerably the amount of concentrates fed.

In the autumn of last year it was decided to carry out an experiment on the farm of Messrs. F. B. & F. J. Pitcher, Burnham-on-Crouch, the object being to ascertain whether silage could effectively take the place of mangolds weight for weight and at the same time effect an economy in the use of cakes and meals.

Messrs. Pitchers' holding at Mangapp, Burnham, consists of 165 acres of arable land and 181 acres of grass (50 acres of this

being marsh land). The soil is a heavy London clay, and as the farm is situated in the driest area in Great Britain (average rainfall 19.28 inches) a very real difficulty is experienced in securing satisfactory crops of mangolds.

The advantages of ensilage under such conditions are numerous, but it will suffice to mention the more important ones.

In the first place an ensilage crop is sown in the autumn, and, provided the proper tilth is obtained and the mixture selected is a suitable one, the crop is not likely to fail. In the rare event of a failure it is possible to resow in the spring. The crop, moreover, is carted off the land in the dry weather and the land can be well cleaned and prepared for autumn wheat. Mangolds, on the other hand, are sown in the spring, and early spring and late winter are bad times to work heavy London clay soils. Furthermore, the period May to July, when the young mangold plant most needs rain, is the driest period of the year and drought frequently ruins the crop. Mangolds are often carted off at a time when the land is wet, and unless the autumn is particularly favourable it is impossible to prepare the land for an autumn crop. Consequently mangolds are frequently followed by a spring corn crop, and spring oats in particular are seldom successful in Essex, for unless they can be sown in February they are almost invariably badly "bottled."

A crop for ensilage requires a great deal less labour than for mangolds, both in cultural operations and in its subsequent management. Mangolds, for example, have to be carted from the clamp, cleaned, pulped and mixed with the chaff before feeding. The silo on the other hand was arranged so that the silage can be thrown down the shoot on to the barn floor from which it is fed to the cows.

Mangolds are gross feeders and unless heavy dressings of artificials and farmyard manure are applied they make a big drain on the fertility of the soil. If a suitable mixture of cereal and leguminous seeds are grown for ensilage the demands on the soil are considerably reduced and the store of nitrogen in the soil may even in some cases be increased.

Silage, particularly when the mixture consists of a considerable proportion of leguminous seeds, is much richer in albuminoids than mangolds, and Messrs. Pitcher were anxious to find out whether by using silage it would be possible for them to reduce the amount of purchased feeding stuffs in use. It was to obtain information on this point that the experiment was carried out.

The Silage Crop.—The crop grown for ensilage consisted of a mixture of tares, oats and beans, in the proportion of 3 bushels of tares, ½ bushel of oats, and ½ bushel of beans per acre. The mixture was not a very suitable one as there were not enough beans and oats to hold up the tares. Consequently the crop was difficult to harvest and a rather large proportion was left in the field. (This year the proportion of beans and oats has been increased and better results are looked for.)

Approximately 5 tons per acre of silage were taken from the silo, which was of the wooden stave pattern. An analysis of the silage gave the following percentage results* :—

Moisture	70·84
Oil	1·43
Crude albuminoids	4·86
Carbohydrates	10·46
Fibre	9·32
Ash	3·09
	100·00

A herd of 30 dairy cows is kept on the farm. For the purpose of the experiment eleven cows were selected and divided into two lots—Lot A consisting of six cows and Lot B of five cows. The average number of days since calving to December 6th, when the experiment began, were for Lot A 91 days and for Lot B 81 days.

Experimental Rations and their Feeding Value.—The following experimental rations were drawn up :—

Mangold Ration.	*Silage Ration.*
50 lb. Mangolds.	50 lb. Silage.
10 lb. Meadow hay.	10 lb. Hay.
18 lb. Oat straw chaff.	4 lb. Dried ale grains.
4 lb. Dried ale grains.	3 lb. Concentrates.
5 lb. Concentrates.	

The concentrates consisted of a mixture of decorticated cotton cake and bean meal in the proportion of 3 to 2.

The rations contained the following amounts of dry matter and digestible constituents (lb.) :—

	Dry. Matter.	*Digestible Constituents.* *Protein.*	*Fat.*	*Carbo-hydrates & Fibre.*	*Production Starch equiv.*
Mangold Ration ...	38·5	2·50	·77	18·6	15·5
Silage Ration ...	29·9	2·46	·89	12·7	13·5

The mangold ration as set out is the ration normally fed,

* We are indebted to Mr. F. Knowles, of the Institute of Agriculture, for these figures.

and it was thought undesirable to modify it. It will be noted that it contains considerably more dry matter and a higher starch equivalent than the silage ration, a difference accounted for by the somewhat large quantity of oat straw chaff included. Messrs. Pitcher were anxious to ascertain whether by using silage they could dispense with the oat straw altogether. Had the amount fed in the mangold ration been reduced to 8 or 10 lb. both rations would have contained approximately the same starch equivalent and digestible carbohydrates.

Times of Feeding, &c.—

5.30 a.m.	Dried grains fed.
7 a.m.	Cows watered.
7.30 a.m.	Half silage (25 lb.) to silage-fed cows.
	Half mangolds and chaff to mangold-fed cows.
10 a.m.	Concentrates given.
2 p.m.	Other half of silage or mangolds and chaff.
4.30 p.m.	Watered.
5 p.m.	Hay.

The hay was weighed several times throughout the course of the experiments, and averaged 10 lb. per head per day.

Experimental Results.—The experiment commenced on December 6th, and the arrangements for the two lots were as follows:—

6th Dec. to 2nd Jan. (incl.)	*3rd Jan. to 30th Jan. (incl.)*
Lot A. Mangold Ration.	Lot A. Silage Ration.
Lot B. Silage Ration.	Lot B. Mangold Ration.

Lot A thus received the mangold ration for 28 days and Lot B the corresponding silage ration. On 3rd January the rations were changed over, Lot A receiving the silage ration for 28 days and Lot B the mangold ration for the same period. The cows were milked twice daily, and the milk from each cow was weighed at every milking. The results are set out in Table 1.

TABLE 1.

MANGOLD RATION.

Lot A. 6th Dec.—2nd Jan. (incl.)		*Lot B.* 3rd—30th Jan. (incl.)	
Name of Cow.	*lb. of milk during the period (28 days).*	*Name of Cow.*	*lb. of milk during the period (28 days).*
Wringle	1,203·0	Duchess 2nd ...	617·5
Poley	819·0	Smutt 2nd ...	793·0
Spot	552·5	Curly	1,417·5
Frost 3rd ...	537·5	Ada	962·0
Darlington ...	901·0	Daisy	375·0
Beauty	552·0		
Total Milk ...	4,565·0 lb.	Total Milk ...	4,165·0 lb.

Total Milk from Mangolds ... ... 8,730·0 lb.

SILAGE RATION.

Lot A. 3rd—30th Jan. (incl.)		*Lot B.* 6th Dec. to 2nd Jan. (incl.)	
Wringle	1,269·5	Duchess 2nd ...	616·5
Poley	894·5	Smutt 2nd ...	803·0
Spot	488·5	Curly	1,275·5
Frost 3rd ...	474·5	Ada	1,029·0
Darlington ...	1,011·5	Daisy	398·5
Beauty	612·0		
Total Milk ...	4,750·5 lb.	Total Milk ...	4,122·5 lb.

Total Milk from Silage ... ... 8,873·0 lb.

There is a gain of 143 lb. of milk over a period of 28 days in favour of the silage ration, a small increase it is true, but probably a real one. Lot A undoubtedly did considerably better on the silage than on the mangold ration. Inspection of Table 1 shows that when the silage ration started on 3rd January all the cows save Spot and Frost increased their milk yield. Spot and Frost had both been calved for over four months and a big falling off in the milk yield was inevitable. Wringle and Poley had been calved 78 days and 86 days, respectively, when the mangold ration ceased and the silage ration began, and in the subsequent 28 days the milk yield of both cows increased considerably instead of declining gradually as would normally be expected.

Lot B receiving silage from 6th December to 2nd January was changed over to mangolds on 3rd January. During the subsequent 28 days the milk yield of three of the cows declined slightly, as would normally be expected. One other remained stationary, whilst the fifth showed a considerable increase as the result of a change to mangolds. The evidence, therefore, seems to indicate stimulating influence by silage on the secretion of milk.

No difficulty whatever was experienced in feeding the silage to the cows, and it soon became evident that they preferred it to mangolds. When the cows came back to their stalls after being turned out, those fed on the mangold ration habitually made for the stalls of the cows receiving the silage ration and licked out the mangers. Moreover, every morning when the cows were turned out they made straight for the sump at the foot of the silo, and there was vigorous competition for the silage juice despite the fact that it had rather an objectionable smell—somewhat resembling that of a tannery.

The change from mangolds to silage and *vice versa* had no adverse effect on the milk yield, and a close inspection of the

daily yields at the changing dates gives no indication that any change in the feeding had taken place.

Effect of Silage on the Quality of the Milk.—Unfortunately it was not possible to take samples of milk from each cow daily, so that no detailed information concerning the effect of silage on the quality of the milk was procured. A few days after the experiment began samples of milk were taken morning and evening and analysed from all the cows taking part in the trial, and again on 12th January, nine days after the rations were changed over, samples were again taken and analysed. The results may be conveniently summarised as follows:—

	Fat. Per Cent.
Lot A.	
Average quality of Milk from Mangold Ration ...	3·56
" " " " Silage Ration ...	3·50
Lot B.	
Average quality of Milk from Silage Ration ...	4·60
" " " " Mangold Ration ...	3·96
Average percentage of fat in milk produced from Mangold Ration ...	3·74
" " " " " " Silage Ration ...	4·00

Little importance can be attached to the apparent improvement in the quality of the milk from silage, since it was entirely due to a fall in the quality of the milk from Lot B when changed from the silage ration to the mangold ration. The quality of the milk from Lot A was practically the same on both rations. While it is impossible to lay any stress on the figures suggesting an improvement, the result shows there is no reason to anticipate any adverse effect on the quality of the milk by substituting silage for mangolds.

In the United States some of the milk-condensing factories have refused to accept milk from dairies where silage is fed, but this action is by no means general, and the rapidly extending use of silage is evidence that the prejudice against it is steadily being overcome. It is difficult to ascertain the specific reason for such objection, although it is maintained that experts can detect an odour of silage in milk from silage-fed cows. In the experiment in question no such noticeable odour or flavour was associated with the milk, and no complaints were made by the consumers. If milk is reasonably handled and properly cooled no objection should be experienced. If on the other hand milk is left uncooled in an atmosphere smelling strongly of silage it will quickly pick up the flavour of the material—a remark which applies in connection with the use of several other feeding stuffs.

The Relative Cost of the Mangold and Silage Ration.—The question which naturally arises from consideration of the above experiment is: "Has silage proved an economical substitute for mangolds?" As this was one of the points upon which information was sought a detailed account of the cost of growing and feeding the mangold and silage crop was kept, and from this record the following summary has been prepared:—

Cost of Mangolds per Ton.

	£ s. d.
Cost of growing and clamping mangolds per acre ...	24 0 0
Cost of carting mangolds from clamp and pulping ...	2 16 0
Total cost per acre ...	£26 16 0
Yield of mangolds per acre	15 tons
Cost of mangolds per ton	1 15 9

Cost of Silage per Ton.

Cost of growing silage crop and filling silo per acre ...	10 0 0
Yield of silage per acre	5 tons
Cost of silage per ton	2 0 0

If the purchased feeding stuffs, hay and straw, are taken at market prices the cost of the two rations works out as follows:—

lb.	*Mangold Ration.*	d.
50	Mangolds at £1 15s. 9d. per ton ...	9·5
10	Meadow hay at £6 per ton	6·4
18	Oat straw chaff at £3 10s. per ton ...	6·7
4	Dried ale grains at £11 10s. per ton ...	4·75
5	Concentrates at £19 16s. per ton ...	10·60
	Total cost of food per cow per day ...	37·97d.

Average yield of milk per cow per day	28·3 lb.
Cost of ration per gal. of milk	13·4 d.

lb.	*Silage Ration.*	d.
50	Silage at £2 per ton	10·9
10	Meadow hay at £6 per ton	6·4
4	Dried ale grains at £11 10s. per ton ...	4·75
3	Concentrates at £19 16s. per ton ...	6·36
	Total cost of food per cow per day ...	28·41d.

Average yield of milk per cow per day	28·8 lb.
Cost of ration per gal. of milk	9·9 d.

The results are shown graphically in Fig. 1. In spite of the somewhat greater cost of silage, the silage ration has proved to be much more economical than the mangold ration, in large measure owing to the saving on the cake bill.

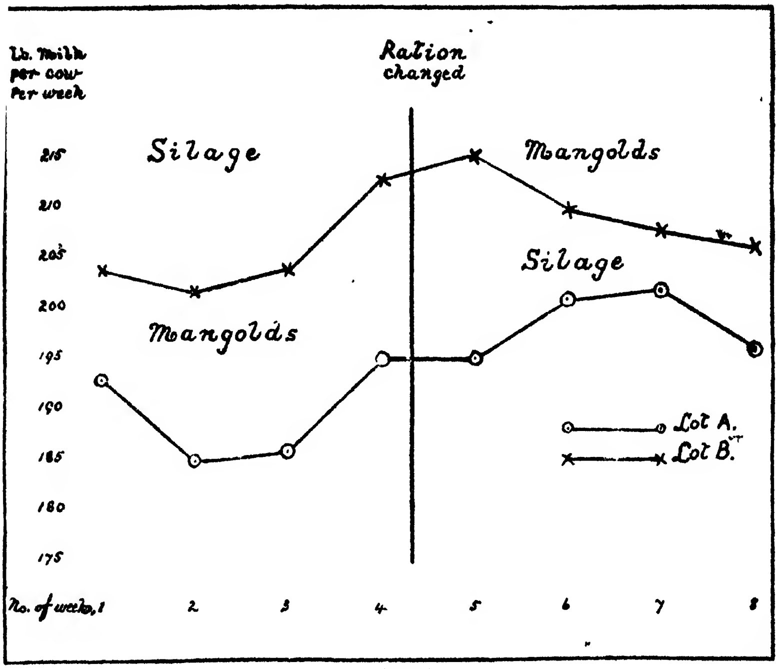
Lb. milk per cow per week
Ration changed
Silage
Mangolds
Mangolds
Silage
215
210
205
200
195
190
185
180
175
No. of weeks, 1
2
3
4
5
6
7
8
Lot A.
Lot B.

FIG. 1.

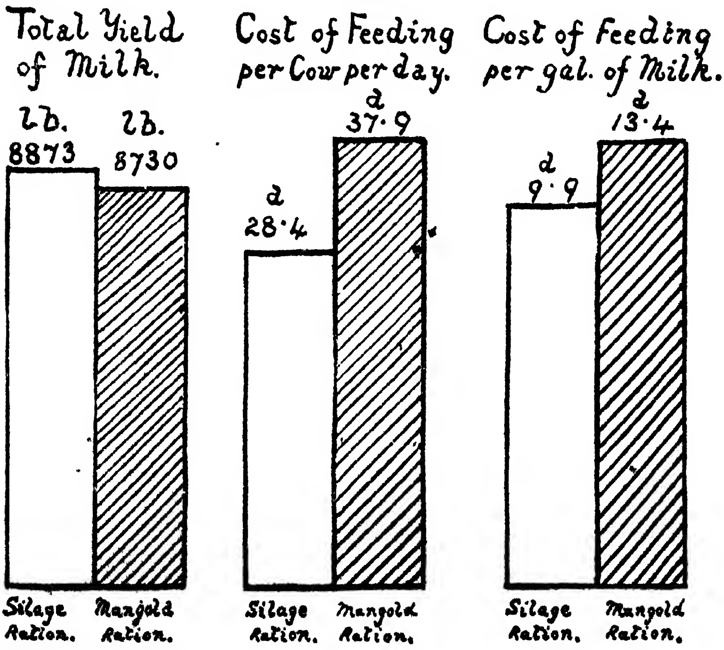
Total Yield of Milk.
lb. 8873
lb. 8730
Silage Ration.
Mangold Ration.
Cost of Feeding per Cow per day.
d 28·4
d 37·9
Silage Ration.
Mangold Ration.
Cost of Feeding per gal. of Milk.
d 9·9
d 13·4
Silage Ration.
Mangold Ration.

FIG. 2.

The Saving on the Cake Bill.—It will be noted that 50 lb. of silage has taken the place of 50 lb. of mangolds, 18 lb. of oat straw chaff and 2 lb. of concentrates. A saving of 2 lb. of concentrates per head per day in a herd of 30 cows is a considerable advantage. If we assume that the herd is receiving winter rations from 15th October to the 15th April, a total of 182 days, the saving works out as follows :—

	£	s.	d.
Decorticated Cotton Cake, 2 tons 18 cwt. at £18 per ton	52	14	0
Bean Meal, 1 ton 19 cwt. at £16 10s. per ton	32	3	0
Total Saving . .	£84	17	0
Saving per Cow	£2	16	6

To the above figure must be added the saving on oat straw. Approximately 44 tons of oat straw would be saved during the six months by a herd of 30 cows receiving 18 lb. per head per day. At £3 10s. per ton such straw has a value of £154.

As to whether it would be desirable to dispense with the use of oat straw chaff depends upon the possibility of putting it to an equally useful purpose on the farm or obtaining a profitable market for it. In any case, if the oat straw chaff remained in the ration it would clearly be necessary to curtail the hay considerably.

In the case in question the total savings in the use of other feeding stuffs stand as follows (assuming that a herd of 30 cows received the silage ration during the whole of the winter period) :—

Saving in purchased feeding stuffs	value	£84	17	0
" oat straw	"	154	0	0
Total ...		£238	17	0
Less extra cost of silage		31	17	0
		£207	0	0

It will be noted that such a favourable economic result from the use of silage is to a large extent due to the fact that the low yield of mangolds per acre is responsible for the high cost per ton. Under the climatic conditions of the east of Essex it is but seldom that the present yield of 15 tons per acre is exceeded to any considerable extent. In interpreting the results such a condition of affairs must be borne in mind. It costs no more to grow and manure a 40-ton crop of mangolds than a 15-ton crop, and where a 30-ton crop of mangolds can be grown with

reasonable certainty the substitution of silage may not be so profitable. Although the cost of feeding stuffs, purchased and home-grown, has fallen considerably since these estimates were drawn up, the fall in prices does not affect the relative economic position of the two rations.

Conclusions.—In the experiment under consideration silage has proved a very efficient substitute for mangolds for dairy cows.

The quality, quantity, and flavour of the milk were not in the least impaired by the use of silage; the evidence available rather tends to show a slight improvement in the yield of the milk.

The silage ration has undoubtedly proved to be more economical than the mangold ration, the cost being 9.9d. per gallon of milk compared with 13.4d. in the case of the mangold ration.

By the use of silage it has been possible to reduce the consumption of purchased feeding stuffs to a very considerable extent. A saving at the rate of £2 16s. 6d. per head in the cost of purchased feeding stuffs for winter feeding (six months) was effected. In addition a very considerable saving in oat straw or hay can be secured.

The season of 1920 was favourable to the mangold crop in Essex, and it seems fair to conclude that for an average season the general economic result would be more markedly in favour of silage. During a dry season, like the present one, a silage crop is able to conserve the soil moisture by covering the ground early in the spring, and a satisfactory crop results. In the case of mangolds the condition of the soil at the time of sowing, the subsequent spell of dry weather, and the fact that the crop does not protect the soil from the direct rays of the sun for many weeks, seriously militates against the growth of a satisfactory crop.

THE SOUTH-EASTERN AGRICULTURAL COLLEGE, WYE.

M. J. R. DUNSTAN, *Principal.*

WYE College has a history long previous to its period of use as an Agricultural College, which only dates from 1894. Founded in 1447 by Cardinal Kempe, Archbishop of London and Canterbury, it served as an institution for the training of twelve priests, and its records as to the ordering of the lives and studies of these men have great interest. When we consider the relations monastic institutions of that age had with agriculture, the translation of a monastic educational college into an agricultural education college is not a great diversion of character.

After the dissolution of the monasteries by Henry VIII, the College passed through several educational vicissitudes, becoming finally partly an elementary school and partly a grammar school. The funds available for keeping the buildings in adequate repair for the carrying on of the elementary school, after the grammar school had given up, proved insufficient for the requirements of our modern state department of education. The Charity Commissioners agreed with Lord Winchelsea (who, in conjunction with the County Councils of Kent and Surrey, was then engaged in establishing an agricultural college) to transfer the College buildings and garden to a body of Governors of the proposed agricultural college for the sum of £1,000, which would be expended in building a new school for elementary education. The South-Eastern Agricultural College was then established under a scheme of the Charity Commissioners, and the first Chairman of the Governors was Mr. E. J. Halsey, Chairman of the Surrey County Council. The first Principal was Mr. (now Sir) A. D. Hall, and the staff included Professor Percival (now of University College, Reading), Mr. Theobald (still at the College), and Mr. F. B. Smith (now at Cambridge). To these gentlemen, but especially to Mr. Halsey and Sir A. D. Hall, is due the credit of establishing a college for the teaching of agriculture on sound and progressive lines, and despite keen opposition from a section of the farming community which was opposed to so-called theoretical teaching of farming, the College continued to progress. Starting with 18 students in 1894, the College now has on its books the names of 205 students in residence. Old students of the College are to be found in responsible and successful positions not only in England but all over the world, and the demand for men trained at Wye is an evidence of the careful and far-

seeing way in which the curriculum and intentions of the College were framed.

The buildings have undergone material alteration and addition, but the original quadrangle containing the Principal's house, Library and Refectory has been faithfully preserved, and such a nucleus of reverend buildings has not a little influence on the general tone of the students.

The present College consists of buildings grouped round five quadrangles, and includes teaching, research and administrative quarters. The upper storey is devoted to students' rooms, each man having a bed-sitting room; 70 of these rooms are available in the College. The kitchens and domestic quarters are in a separate block, but in the original design of the College the mistake was made of not providing room for expansion of these departments.

The aim of the College is not merely to teach practical farming. Everyone with even a small knowledge of agriculture must realise that the routine and organisation of farm work, with its frequent variations according to changing weather conditions and other factors which influence its successful management, can only be thoroughly learnt by undisturbed hard work and experience on a farm. What the College can and does give is instruction in those subjects bearing upon farming which can guide a man in the organisation of the resources at his command and help him to make the best use of his capital, labour, stock and land. The student is aided by seeing the practical working and management of the College farm. There is no doubt that a man will make a better farmer if to the qualities of business administration and thorough practical experience there is added a knowledge of principles and of the reasons underlying and prompting sound and progressive practice—a knowledge which will enable him to vary his methods according to the changing demands of markets, climate and soils.

The College courses are three in number. (1) There is the Agricultural Diploma course extending over three years: this can be shortened to a Certificate Course of two years in the case of students who require more practical and less scientific instruction. (2) The Horticultural Diploma Course covers two years. (3) The Degree Course (B.Sc. Agri., University of London) extends over three years. The conditions for the granting of a degree by the University are not yet entirely satisfactory, and negotiations are proceeding in the direction of changes which should make the qualification of higher value.

It is essential that the agricultural student learning about the composition and uses of manures and feeding stuffs, plant growth,

fungus diseases, etc., should have some elementary knowledge of chemistry and of botanical principles, so that he can feel he is dealing with things of which he has a knowledge and may intelligently apply himself to the solution of difficulties which may occur to him in carrying on his industry of farming. The proper place for the elementary sciences to be taught is the secondary school, but until that desirable result is secured the agricultural colleges must include such subjects in their curriculum, and the method of teaching must proceed *pari passu* if possible with the teaching of agriculture, so that the student's knowledge of chemistry or botany becomes part of his agricultural knowledge.

This, however, is a digression from the work of Wye College, which is endeavouring to put this idea of teaching into practical shape in lectures and laboratory work.

Part of the instruction at the College is given by means of practical classes on the farm, *e.g.*, with implements, veterinary demonstrations, &c. If these classes are to be efficient they must be small, and to secure small classes it is necessary either to increase the number of classes or to employ a large staff. A practical demonstration attended by more than 12 or 13 students may be a waste of time except for those who can get near the the demonstrator. Students are taught the manual operations (ploughing, work with horses, thatching, etc.), but the intention is not to make skilled workers of them—that can only be done by long experience—but to indicate to them the methods, what is meant by good work, time taken, and so forth.

There is a demand for practical teaching of agriculture from the farming community, but what the advocates of such teaching mean is not always quite clear, though as a rule it is probably what they think is *not* taught at agricultural colleges! A student who is going to be a successful farmer must "go through the mill" of routine farm work, and he must supplement his knowledge of stock, crops, soils and manual operations by practical experience relative to the management of men, markets, and financial dealings. Success in farming, as in every other industry, depends upon keen business methods, and a sound knowledge of accounting is not the least necessary qualification.

The system of going as a pupil on a farm is often a very unsatisfactory method of learning farming—the pupil pays a premium and often thinks that therefore he can do as he likes; the farmer may be unskilled as a teacher and permit the pupil to go as he pleases, not initiating him into such important matters as

the business organisation of the production on the farm, the costs of production, the system of keeping accounts and the yearly financial results of the farming. The pupil is often used as cheap labour and is kept at unskilled work too long, gaining no sense of proportion of the value of the different branches of the industry. There are, of course, many exceptions to such an unsatisfactory state of affairs as has been described, but the number of farmers who can and will instruct pupils in the details of their business is very small.

The farmer of the future must have a wider outlook than he of the past. He must combine with his other knowledge some information as to the history of his industry, of the conditions under which his foreign competitors work, of the world markets, of some of the more important economic laws affecting his industry, of recent progress in plant breeding, plant pathology, and engineering, of co-operation, and generally of his position, not as an isolated producer, but as one of an army of producers of goods to supply human wants. He must regard his industry in its relations to other industries, socially, politically, and economically. The agricultural college must therefore stimulate its students in those directions and aid them to become well-informed, broad-minded captains of industry.

The farms at Wye consist of about 450 acres, 390 of which are devoted to agriculture, the remainder being given up to fruit, hops, poultry, market gardening and forestry.

The College farm is always a subject on which the practical farmer loves to discourse, and he points the finger of scorn if it does not pay. The farm is to the agricultural teaching of a college what the laboratory is to the lecture room, a place where demonstration and experiment is carried on to supplement the oral teaching. Its utility lies in its demonstrating different methods (not only those of the locality) of cropping, manuring and management, and its object should be to impress on the student that there are different methods of attaining the same end, and that he must use his intelligence and observation in ascertaining the method most suited to the conditions under which he may be placed. The learner believes and remembers better what he has seen than what he has been told, and it may be necessary to demonstrate bad practice and unsatisfactory methods in order to warn him for his future that commercial and financial success cannot be obtained under such conditions.

An experiment has been made during the past year at Wye College in putting the farm entirely under the charge of a Committee of practical farmers, but it is doubtful whether this

arrangement will prove wholly satisfactory either from the educational or the commercial standpoint.

During the War, in which Wye College lost 13 of its members, a Women's Course was carried on, but it has now closed its doors to women. The demand for women's instruction in agriculture and the allied industries, however, remains, and is unsatisfied owing to the absence of any women's college in England.

The increasing demand from Egypt, India, Argentina and other countries for students to enter English agricultural colleges cannot be satisfied until the arrears of our own students have been cleared off. At present the pressure from English students on the space of Wye, as on that of other colleges, shows little sign of diminishing, but those who wish to take up an agricultural career must be warned that only men with exceptional qualifications can hope to secure appointments, and only those with an adequate supply of capital, well trained and experienced and with business acumen can hope to succeed as agriculturists.

Farming is not, as it was once defined, a career for the man who was not stupid enough for the army and too clever for the Church: it demands a wide knowledge of farming conditions not only in this country but in the countries of our competitors.

The Advisory and Research Departments of Wye are in process of development, and their existence should exercise an excellent influence on the educational side. Owing to the character of farming in the district, questions affecting fruit and hops are of main importance.

The Malling Fruit Station which was started by the College is now an independent unit, but a close connection is maintained with the College, and horticultural students are periodically taken to the station to gain a knowledge of the investigation work carried on there. Short courses in agriculture during the winter months, and in rural science for schoolmasters during the summer, are carried on, but the former courses are of a temporary character, being intended to lapse when the Farm Institute is established at Tunstall.

The policy of the College is to give instruction to the future cultivator by means of the certificate and diploma courses in agriculture and horticulture, to train the scientific expert in the degree course, and to offer opportunities to post graduate students for specialising in investigation work. By a wise expenditure of funds the Governors have equipped the College in a very thorough manner, and their policy would appear to be justified by the reputation of the College and of its students.

BASIC SLAG PROBLEMS.

THE supersession in the steel industry of the basic Bessemer process by the basic open hearth process, with consequent change in the character of the basic slag produced, has created important problems regarding the use of basic slag in agriculture. In place of the old high-grade slag containing 40 per cent. to 45 per cent. of phosphates, agriculturists now usually obtain slag containing only about 20 per cent. of phosphates, and often even less.

In March, 1920,* the subject was discussed by the Faraday Society, and a resolution was adopted recommending the Ministry of Agriculture to appoint a committee to study the basic slag problem. Lord Lee, who was then Minister of Agriculture, acceded to this request, and a permanent committee was set up in July, 1920, consisting of representatives of steel makers, slag grinders and agricultural consumers† "to consider the development and improvement of the manufacture of basic slag and the extension of its use." This Committee has now presented to the Minister an Interim Report‡ which is summarised below.

The Committee discussed: (1) The quantity of slag producible assuming our present steel output to be maintained, and a comparison of this amount with the estimate of Sir Thomas Middleton showing how much slag can advantageously be utilised by farmers in this country; (2) The possibility of increasing the amount or quality of the slag by some method additional to the ordinary steel making processes; and (3) The agricultural value of the slags now obtainable.

(1) **Quantity of Slag Available.**—The National Federation of Iron and Steel Manufacturers has obtained from the steel makers returns of which the following are short summaries. The

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* The report of the discussion "Basic Slags: their Production and Utilisation in Agriculture" was published in the Transactions of the Faraday Society, Dec., 1920, Price 7s. 6d.

† The composition of this Committee is now as follows:— Dr. E. J. Russell (Chairman), Mr. T. Baxter, Mr. G. A. Bellwood, J.P., Mr. Colin Campbell, J.P., Mr. G. Coleman, Dr. Arthur Cooper, Mr. R. R. Enfield, Mr. G. Hatton, Mr. Mannaberg, Mr. G. V. Parker, Mr. H. G. Richardson, Dr. W. Somerville, Mr. J. G. Stewart, Mr. B. Talbot. *Secretary*, Mr. W. R. Black, Ministry of Agriculture and Fisheries, 4, Whitehall Place, S.W. 1.

‡ Not at present to be printed elsewere.

amounts of slag produced in Great Britain in the year ended 30th September, 1920, were :—

As P_2O_5.		*As Phosphate.*		*Quantity.* Tons.
Under	5 per cent.	Under	11 per cent.	22,522
5 and under	7 "	11 and under	15½ "	118,011
7 "	10 "	15½ "	22 "	302,346
10 "	12 "	22 "	26½ "	90,928
12 "	15 "	26½ "	33 "	121,357
Over	15 "	Over	33 "	46,229
			Total ...	701,393*

It may be doubted whether the 22,500 tons of slag containing less than 5 per cent. of P_2O_5 (=under 11 per cent. tricalcic phosphate) would be worth grinding. The 118,000 tons of next higher grade (11 to 15½ per cent. tricalcic phosphate) may be found to have more value than appears from their phosphate content, but owing to high cost of transport and present uncertain knowledge as to their value would not at present be as eagerly sought by farmers as the higher grades. There remain, therefore, some 560,000 tons of slag, containing more than 15½ per cent. phosphate of which only 46,000 tons is of the basic Bessemer type (more than 33 per cent. phosphate).

Before the War the steel makers produced, and the farmers consumed, some 260,000 tons of high-grade slag; last year 46,000 tons only were produced, and apparently even this small production cannot be relied upon in the future.

The above table shows that, as regards units of phosphate, the farmer is not placed on such a short ration as might at first appear. The 260,000 tons of high-grade slag of pre-war days contained 9,880,000 units of phosphate; the 560,000 tons of last year's slag contained 13,400,000 units. Adding in the units contained in the 140,000 tons of the lowest two grades the figure becomes 15,200,000 units.

The problem appears in a less favourable light, however, when it is remembered that farmers before the War were not using anything like as much slag as in the opinion of competent authorities they might with advantage have used. Sir Thomas Middleton estimated that no less than 890,000 tons per annum might be used in the United Kingdom, equivalent to 33,820,000 units—some 2½ times the present output.

* Excluding the production of four firms from whom no returns were received.

The amounts disposed of for manurial purposes and for other purposes in Great Britain in the year ended 30th September, 1920, were as follows :—

As P_2O_5.	*For Manurial Purposes.* Tons.	*Other.* Tons.
Under 5 per cent.	5,423	15,459
5 and under 7 ,,	26,745	86,060
7 ,, ,, 10 ,,	223,292	53,321
10 ,, ,, 12 ,,	84,419	2,792
12 ,, ,, 15 ,,	122,052	1,169
Over 15 ,,	46,309	—
	508,240*	158,801*

TOTAL ... ... 667,041* tons.

The total deliveries of basic slag in England and Wales in 1919-20 were 407,000 tons, as compared with an area under crops and grass of 26,507,000 acres, an area under permanent grass of 14,487,000 acres, an area under clover and rotation grasses of 2,448,000 acres, and an area under mountain and heath land used for grazing of 4,162,000 acres. Very little basic slag is coming from abroad: in 1920, 17,584 tons were imported and 11,154 tons were exported.

(2) **The Possibility of Increasing the Amount or Quality of Slag.**—The Committee is assured that practically the whole of the phosphorus entering the iron works is contained in the slags mentioned above, and that there is no significant loss or balance unaccounted for. It follows that if the output of steel remains constant the slag figures will remain substantially as they are except that the highest grade will tend to become more scarce and the others proportionately to increase. The Committee has therefore enquired into the possibility of increasing the phosphorus output by some method additional to the ordinary steel-making process, such as the following :—

(*a*) *Addition of mineral phosphate to slag in the ladle.*—This would be advantageous only if the agricultural value of the mineral phosphate were improved.

Four experiments carried out by Mr. George Hatton at the Earl of Dudley's Round Oak Works, in which mineral phosphate was added to slag in the ladle in the proportion of approximately ½ cwt. of rock phosphate to a ton of slag, may be summarised as follows (average of four experiments) :—

* Of these totals, 260,187 tons were ground in manufacturers' own works, 248,053 tons were sold for grinding elsewhere, 75,233 tons were sold for purposes other than fertilising, while 83,568 tons were dumped with all kinds of works rubbish and were consequently valueless for manurial purposes.

	Composition of Rock Phosphate.	*Composition of Slag Before Addition.*	*After Addition.*
	per cent.	per cent.	per cent.
CaO	51·92	48·75	50·4
P_2O_5	35·63	9·66	10·66
Solubility	17·87	88·88	76·95
Total Calcium Phosphate	77·82	21·05	23·23

There is no indication of any sufficient alteration in the mineral phosphate to justify the process.

(*b*) *Use of iron ore containing more phosphorus or addition of phosphates in the blast furnace*, with the express purpose of obtaining a more phosphatic pig iron and therefore a more phosphatic slag. It is agreed that this would constitute a satisfactory solution of the agriculturist's problem, but from the steel maker's point of view it adds to the cost of production of the steel, and therefore could be adopted only if the price of the slag were sufficiently attractive.

(*c*) *The re-introduction of the two lowest grades of slag into the blast furnace*, whereby a more phosphatic pig iron would be produced, which, again, would yield a higher phosphatic slag. This course would not increase the total units of phosphate, but would increase the proportion of higher to lower grades.

(*b*) and (*c*) are still being investigated by the Committee.

(3) **The Agricultural Value of the Slags now obtainable.**— The Committee felt bound to consider the possibility that no improvement may be practicable in the quantity or quality of basic slag, and it has therefore initiated experiments to ascertain the agricultural value of present-day slags in comparison with the basic Bessemer slags. These experiments were put in hand at the beginning of the enquiry. Mineral phosphates are included in the trial in order to ascertain whether they could justifiably be used in increasing the phosphatic content of the slag.

Fortunately, the Agricultural Education Association had already begun a series of trials on arable and hay land, and Dr. G. Scott Robertson has carried out various hay tests and has projected feeding trials. These trials give some, but not all, of the information the Committee needs. Further experiments have, therefore, been arranged at Rothamsted to elucidate the following points:—

1. Whether the soluble and insoluble open hearth slags differ in agricultural value; if so, whether some method of evaluation can be devised better than the present citric acid test.

2. Whether the open hearth slags are inferior to Bessemer slags when applied in quantities containing equal amounts of phosphorus.

3. Whether finely-ground mineral phosphates differ greatly in value from basic slag.

4. Whether the manurial effect of basic slag is wholly dependent on its phosphate content, or whether other constituents (manganese, etc.) should be considered of value.

To test the first three problems, a series of experiments has been arranged at Rothamsted on meadow land laid in for hay, and on root crops; also a feeding trial with sheep (six plots, each of approximately 2 acres). The fourth problem is more difficult, but it is being studied, in the first instance, in pot experiments at Rothamsted. The results so far obtained from the fourth series lend no support to the idea that manganese is of value.

THE SCARCITY OF SWALLOWS.

HENRY BOASE.

THIS summer the scarcity of swallows and the martins has been a subject of general remark, and various theories have been put forward as to the reason of the scarcity. Some of these theories have been rather fantastic, and a few notes on the subject may be of interest.

Some of the factors which may affect the numbers of these birds have been examined and a general statement has been prepared. In doing so it has been thought advisable to include the swift with the *Hirundinæ*, as a general similarity of its feeding habits causes it to be affected by some of the conditions which may influence the distribution of the swallow and its relatives. The four birds (swallow, martin, sand martin, and swift) are at times referred to hereafter as a group, but it must be understood that this is a matter of convenience only. The swift has no relationship with the Hirundines and differs in many important features of structure and habit, but, feeding in the air in common with the three true Hirundines, it may be considered along with them in that connection.

These notes express the situation as gathered in Scotland, representing a point of view rather than an authoritative statement, and are not intended to represent any degree of finality in so complex a matter.

Certain general features call for some explanation, and accordingly an account of certain aspects of habit is given in order to make clear the ideas put forward in connection with the reduction of numbers.

Food Habits.—As a group, these birds are remarkable for the manner in which they feed. Practically all their food consists of winged insects secured in flight; in the swallow only have I noticed any attempt to secure insects on the ground. Some are also picked from the surface of still water while the bird is drinking or bathing, but these represent a very small proportion of the total quantity consumed. All members of the group seem to spend their time almost solely in obtaining food. The swallow and martins appear to hawk around the neighbourhood where the nest is situated, and seldom wander unless under stress of weather. In high wind, the flight of the insects on which they feed is naturally impeded, and the insects tend to gather in sheltered places, in the lee of woods, in hollows, etc., and are pursued there by the birds. All the Hirundines seem

to show a preference for damp and marshy areas, and may be attracted by the wealth of insect life there met with. Swifts, on the other hand, are far less confined and seem to seek food over a wide area. Also they hawk at higher elevations than the Hirundines and may consequently feed on different insects. In Scotland, they feed commonly over moors on the high ground where the swallow and its congeners never go, miles distant from their nesting places.

The food supply, aerial insects, is liable to considerable variation as a result of weather changes—high winds, heavy rain, and frost. The last two, in particular, seem likely to be the most potent—the rain by " washing down," and the frost by " cutting down " and so killing off insect life. Consequently the group is endangered through possible food shortage as a result of these weather fluctuations.

The insect life which supplies the food of these specialised birds does not appear to be defined beyond " winged insects." It is clear, however, that the insects themselves will be affected by weather conditions, and that to some extent the species present in any given area will be dependent on the vegetation growing there, and on the moisture in the soil and atmosphere. Drought may cause a falling-off in the number of insects, though this will affect different species in different ways, and changes in the vegetation of an area—the cutting down of woods, or even the change from arable land to pasture—will probably have an effect on the number and species of the insect population. Consequently the matter of food supply for the birds depends on the weather and vegetation, which vary and interact the one on the other.

Migration.—The four species under consideration pass through the dangers of migration twice each year in their journeys to and from these islands. Ever since the reality of these great flights was accepted, it has been a matter of surprise that the migrant species should be capable of making so prolonged an effort. Recent investigations tend to overthrow the older conception of a thousand miles flight in a night, but nevertheless these movements, even if taken in stages, indicate an endurance quite unexpected. In migration itself, the overseas flights are naturally the most dangerous, and it is during these journeys that weather changes can cause great havoc in the ranks of the travellers. Weather can affect migrants in two important respects, the one in regard to the actual physical effort, the other in regard to food supply when land is reached. The species in question travel for

the most part during the day, and no doubt refresh themselves with such insects as cross their path during the flight, but cold and wet weather must take a heavy toll of travel-weary birds, as a result of exhaustion from want of food.

Conditions differ somewhat in spring and autumn. *In spring*, the birds tend to follow the lines of the isotherms as the season advances; consequently disaster is less likely to overtake the main body of migrants through unexpected cold. Exceptional weather in May, however may kill off many birds soon after their arrival. *In autumn*, an early break up of the weather may cause considerable losses among the young of the year making their first journey south. In this connection, it is probable that food supply and not temperature is the real crux of the matter, as frequently the birds travel overland at least under severe conditions, in wind and driving rain, at times when the real urgency of departure due to cold does not press upon them.

It has become increasingly evident that migrants (particularly the species under consideration) do not in general on arrival occupy the first suitable area they come to in their journey, but pass on to the particular place which was their nesting ground in the previous year, or, in the case of young birds, the scene of their upbringing. Further, there is every reason to believe that the same wintering areas are occupied from year to year, and that a constant route is traversed between the summer and winter quarters. Admittedly these are matters hard to prove, but the repeated return has been demonstrated frequently in the case of the swallow and house martin, and the probability of the succeeding ideas seems reasonable.

Decrease of the Swallows.—The question of the gradual decrease of the swallows is a complex one, and the decrease is probably not due to immediate causes but may extend back over many years. We are recording to-day the effect of some change in conditions which has reacted unfavourably on the group. The last thirty years or so have been marked by several remarkable extensions of breeding range, notably in the case of the starling, the tufted duck, and the great crested grebe, while other species have become restricted. The great reduction in the number of predatory birds and animals doubtless has had its effect in certain cases, but notwithstanding the study which has been given to these variations, very little indeed has been elucidated as to their real causes. We have only to consider the vast changes which have been made in the conditions of this country—the draining and improvement of agricultural land, the development

of industry (can we measure the bad influence of coal smoke?), the changes from forest to clearings, pasture to arable and the reverse—to realise that it is actually surprising that the changes are so small.

It has been established that in spite of the recollections of the "oldest inhabitants," there has been little or no change in the average weather conditions of Great Britain within the records available; consequently, in spite of fairly general opinion, weather as a sole cause must be ruled out.

The effect of weather on average food supply is accordingly improbable, but from what has been stated regarding the homing instincts of these birds, it can be seen that a series of unfavourable summers might bring about a decrease which would take some years to remedy. Any lack of food reacts on the adults themselves, rendering them less vigorous and causing a reduction in the brood, and the brood in turn is affected by the prevailing shortage. Two or sometimes three broods are normally reared in a season, and obviously smaller broods, and the possibility that only two broods, and in some cases but one brood, will get away, are conditions which would tend to result after bad weather, while the condition of both adults and young will be less favourable for their southward journey. Under average conditions, the annual increase just about balances the appalling losses of life during the remainder of the year, so that a succession of cold wet summers—or even one (1920 for instance)—leaves a decided mark on our bird population. This loss must be made up by the birds normally nesting in this country, since the number of strangers which turn aside and become as it were new settlers cannot be large.

Further, it is possible that the gradual draining of many parts of Great Britain is responsible for more permanent changes. To take a definite area, the Carse of Gowrie, bordering the Tay Estuary, has undergone considerable changes within comparatively recent times. At one time marshy, now well drained, not so long ago one of the leading grain-growing areas, now largely given to grazing, even within the last twenty years the reduction in numbers of swallows has continued steadily. At one time, the villages were the homes of hundreds of house martins; now only a few pairs return. On the other hand, in certain of the glens in the Grampians, the numbers appear to be much the same as in years past. In these glens, little or no change has come about in the character of the country except where holdings have been abandoned, and on the whole, numbers seem to be fairly steady.

As already stated, the swallows show partiality for wet ground, and in Northern Europe, where insect life is abundant in the swamps, these species summer in large numbers. In this country, the Hirundines roost in large numbers in reed beds where these exist, particularly in the autumn when collecting for their departure. The food supply of these marshy areas is possibly the attraction which has developed this habit.

There appears to be a tendency for the swallows to make an earlier departure. During recent years, in the Tay Estuary, considerable passage movements have been met with annually in July, in the second week in some cases, and the sand martins are moving sometimes in the first week. Many of these must be young birds, but with them a considerable proportion of adults is usual. It is clear, therefore, that in the case of these birds it is scarcely likely that more than one brood has been reared, as in Scotland, some districts, even in Forfarshire and Perthshire, are not colonised until the second week of May, and in the glens the house martin may only start building in the beginning of June.

It has been suggested in certain quarters that perhaps some special dangers have arisen which confront the birds during their migration, but it seems scarcely conceivable that destruction could be wrought on a scale sufficient to make a marked difference over the whole area of Great Britain. It is quite possible that an exceptional storm might cause a local shortage at some point owing to the death of the birds building there, but it has been proved that the various birds occupying a district do not necessarily arrive or leave at the same time Consequently, in general, some get through to preserve a colony.

It is apparent that the swift, in spite of the similarity in some of its habits to those of the swallow group, has not suffered so great a loss in recent years. In fact, in Scotland, the swift is recorded as exceptionally numerous in 1918, pointing to tho fact that it is at least maintaining its footing there. In view of the fact that only two young are reared in a brood and one brood only is brought up during the season, the mortality in migration and in its winter home must be very much less than that of the swallows and martins, a problem itself worthy of investigation.

PACKING APPLES IN BOXES.

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Box packing of apples is apt to appear rather complicated to the uninitiated, and the older methods actually were so, because considerable judgment was required to decide which method to use for a given size of fruit. Several methods might be used for the same size, and there was always doubt until the pack was nearly completed whether it could be made the right height or not. Packing has now been reduced to an exact science, and the standard method is very simple once the details have been mastered. There is only one method for each particular size, and when this is followed a good and tight pack is obtained every time.

When apples were first boxed in this country, about ten years ago, the most up-to-date methods then in use in the Western States were adopted. These methods have long been superseded in their country of origin, but are still largely used over here. The square pack is now little used, but the off-set pack has still some supporters. It may be attractive under some conditions, but it cannot always be used. The diagonal pack, however, can be used for any size or shape of apple, so long as the fruit is graded correctly, and experience has proved it to be much superior to any other pack both in remaining tight after much handling and in taking great pressure without bruising the fruit. Further, the use of one pack only has obvious advantages.

Even when the diagonal pack is used, the result is not always satisfactory. The shape of our fruit is often blamed, but it is usually the case that the method of grading is not understood. A complete system, described below, has now been adopted, and with it there are no uncertainties. The chief feature of this system is that the apples are chosen at the time of packing. They are not merely previously divided into sizes which are themselves packed: this requires great ingenuity and is often impossible. The idea of first dividing up into fixed sizes and then trying to find a pack that will suit the sizes is the snag which so many growers are up against. They continue to grade by means of rings or cards or by employing machines having the same principle, and then try to pack the sizes thus obtained. Apples, however, are so irregular in shape that this method can-

not arrange grades of even approximately the same size. The result is that many packs have to be used, sometimes two in one box: the same sizes may be packed in several ways, and even then the finished pack is very often too high or too low and the fruit is consequently bruised. To some extent this is obviated by turning some of the apples or by making up with wood wool or in other ways—an unnecessary complication with results which are seldom satisfactory. If it is carefully followed the newer system gives a better result and does away with all needless troubles. The actual placing of the apples in the box requires very little practice and less skill, but what is generally known here as grading does require a certain amount of both skill and practice. This grading is for both quality and size, but selection for size would be more correctly described as sizing. No skill is required to remove blemished, damaged or poorly-coloured fruit, though care is necessary. The real difficulty lies in selecting the correct sizes for packing, or sizing. It is usually stated that successful packing depends upon selecting apples of *as nearly the same size as possible*. There is more in this statement than meets the eye. Under the older systems apples are sized by passing through rings or some similar device. Apples, however, are not round like tennis balls, and this method only measures the maximum diameter. Even if the actual average diameter could be measured, it would be useless, as it is only one of the factors included in size.

The point that really matters is the space occupied or bulk of the apple. Unfortunately this cannot be ascertained satisfactorily or even approximately by any practicable mechanical form of sizing. Most of the up-to-date machines now in use abroad size by weight, and if the apples are divided into a sufficient number of sizes, this is an improvement. No mechanical apparatus, however, has yet been produced which will divide the apples into sizes ready for packing. A little consideration will show why this is so. If a size comes out so that 156 apples would just fill a box, a little calculation, or a reference to the table given on p. 538 below, will show that the nearest numbers that will give an even number of layers are 150 and 163. If the packer puts in 150 the pack will be too loose: if he puts in 163 it will be too tight: the result in either case will be damaged fruit. This is an important point, and it may be clearer to those who are accustomed to thinking of apples as so much in diameter, if put in another way. It should be borne in mind that however near apples are in size to each other, there must still be some

variation. Even supposing that apples could be accurately measured for diameter, the difficulty of taking the height into account would still remain. Trial may show that a certain run of fruit packs quite well if the sizes are $2\frac{1}{4}$-$2\frac{1}{2}$ in., $2\frac{1}{2}$-$2\frac{3}{4}$ in., and so on, but in another run of longer apples these might not be suitable at all, and $2\frac{1}{8}$-$2\frac{3}{8}$ in., $2\frac{3}{8}$-$2\frac{5}{8}$ in., and so on, might be the sizes that would pack. In each of these sizes the variation would be $\frac{1}{4}$ in., but it comes in a different part of the scale. The correct starting point could not be ascertained until a trial box had been packed, and much time would be wasted. *The final selection for size cannot be made by machinery; it must be made by eye.* This need not alarm the would-be packer, because there are so many guides to help in the choice, that reasonable care is all that is required.

It would be both tedious and damaging to the fruit if all sizes were before the packer at once, so that a large number had to be rolled over to find the right size. It is not essential to divide the apples as picked into more than three sizes, large, medium, and small. There is no objection to using a machine for this, but in no case should the variation in size be less than $\frac{1}{2}$ in., and it must be clearly understood that this simply reduces the number of sizes from which the packer has to choose, and will not secure a size which can be packed right away without further selection. As will be shown, after the first few apples are placed in the box, the size and position of the rest are determined by those already packed.

It has already been stated that however nearly the same sizes are selected, there must be some variation. The extent of the variation is a matter for consideration. There is no doubt that the more nearly the apples are of the same size, the more easily and quickly can they be packed and the better will be the result. The maximum number of sizes, for example, between 213 (about $2\frac{1}{4}$ in. average diameter) and 113 (about $2\frac{7}{8}$ in. average diameter) is 9. If the quantity of apples to be packed is sufficiently large, this number of sizes can be packed most easily and quickly, and will give the best results. Where few apples are available, however, fewer sizes must be selected. This will not prevent the system being used, but it introduces an element of uncertainty; the selection of sizes requires more consideration and is less automatic, and the result depends upon the packer more than on the system. It is, therefore, better to make the maximum number of sizes, in fact to select apples of *as nearly the same size as possible.*

Having decided to pack on the *diagonal system*, to abandon the attempt to size by means of a mechanical grader only, and to make a final selection for size at time of packing, the necessary appliances and the actual method of sizing and packing remain to be determined.

Appliances.—A table to hold the fruit is necessary. The height and width should be 3 ft.. and the length 5 ft., or more as convenient. Stout canvas should be stretched across the top, and to prevent too great sagging, webbing such as is used in chair making should be fixed 3 in. below. A little under this a shelf to hold lining paper will be convenient.

A box rest to hold one end of the bottom of the box level with the top of the table and the other about 9 in. lower is required. This may be attached to the side of the table, or a separate holder may be made, but it should be so placed that the packer may stand with the fruit on his right hand and the box in front of and sloping towards him. If wrapping papers are used, a suitable receptacle may be hung on the side of the box.

The supply of boxes must be of the recognised size and material, or the proper strength and elasticity will not be obtained. The inside measurements of the box, and the measurements of the pieces of which it is composed are:—

Made-up box, 18 x $11\frac{1}{2}$ x $10\frac{1}{2}$ in.
2 solid ends, $11\frac{1}{2}$ x $10\frac{1}{2}$ x $\frac{3}{4}$ in.
4 side pieces, $19\frac{1}{2}$ x $4\frac{3}{4}$ by $\frac{5}{16}$ in.
4 top and bottom pieces, $19\frac{1}{2}$ x $5\frac{1}{4}$ x $\frac{5}{16}$ in.
4 cleats, 11 x $\frac{3}{4}$ x $\frac{1}{4}$ in.

A box press for holding down the ends while the box is being nailed, or some effective contrivance for attaining this object, is essential, together with a supply of cement coated nails and a hammer, a nail drawer and a box opener.

The Numerical System.—Only four packs are necessary to take all sizes from 270 to 36 (that is from about 2 to $5\frac{1}{2}$ in. in diameter). They are known by the number of apples in the rows across the box: 3-3, 3-2, 2-2, and 2-1 diagonal. For example, the 3-2 pack has 3 apples in the first row and 2 in the second row, and so on 3 and 2 alternately. The 3-2 pack has always 5 tiers or layers of apples, the 2-2 has 4 tiers, the 2-1 has 3 tiers, and the 3-3 has 6 tiers.

There are 10 sizes in the 3-2 pack, 10 in the 2-2, 5 in the 2-1, and 4 in the 3-3. The pack is further distinguished by stating the numbers of apples in the vertical rows after the above. For instance, the 3-2, 6-5 pack has 3 and 2 apples alternately in the

horizontal rows and 6 and 5 alternately in the vertical rows. The total number in the box is thus easily calculated. In this case there are 3 rows of 6 and 2 of 5 in the first tier or layer, or 28 altogether. In the next tier, as explained later, there will be 3 rows of 5 and 2 of 6, or 27 apples. As stated above there are 5 tiers in the 3-2 pack, and as the first tier contains 28 apples, there will be 3 of 28 and 2 of 27, making a total number of 138 apples in the box. This number is used to indicate the size of apple packed. In order to avoid calculating in this manner, a table of sizes is given at the end.

Preparing to Pack.—Having placed the apples, after preliminary sizing, upon the packing table, and the box upon the box rest, the packer stands so that the apples are on his right hand and the box in front of and sloping endways towards him. Wood wool should not be used, because if little is used it has no effect, and if much is used the pack will be loose. Only one thing will keep apples tight, and that is apples. The lining paper (tissue 18 or 20 x 30 in.) is placed on the shelf below the table, and wrapping papers, if used, in a suitable receptacle hung upon the side of the box.

Two pieces of lining paper are folded and placed so that each piece covers rather more than half the bottom, and comes up the side and hangs over, to be folded in to cover the apples when the pack is complete.

The first layer packed will probably be more level than the last, and therefore it is arranged that the first layer packed shall be exposed when the box is openend, *i.e.*, the bottom of the box at time of packing afterwards becomes the top.

Rules for Deciding Pack to be Used.—These rules must be strictly followed. In the 18 in. box all sizes and shapes of apples are packed on their side with the eye towards the end of the box.

1. If 5 apples of as nearly the same size as possible will go in a row across the box, but not 6, the pack is 3–3. This is only used for special highly-coloured dessert fruit, as the sizes are too small for ordinary use.
2. If 4 apples will go in a row across, but not 5, the pack is 3–2.
3. If 3 apples will go, but not 4, the pack is 2–2.
4. If 2 apples go, but not 3, it is 2–1.

It has been said that these rules are not reliable, because sometimes when 4 have gone in and not 5, they would not pack 3–2, but this is due to a misunderstanding of the method of sizing.

Method of Sizing at Time of Packing.—When the apples are being packed by the method about to be described, the apples should be as nearly as possible of the same size, and of such

a size that they will just fit the space available, keep the rows at right angles to the box, and in the case of all but the first tier, keep the rows in line with those beneath. Care should also be taken to keep the apples well pressed towards the end of the box. When the first tier is nearly completed, it may not exactly reach the end of the box. If the last row will not go in, the whole tier should be looked over, and 2 or 3 of the larger apples taken out and replaced by slightly smaller ones. If the tier is then pressed firmly towards the end at which packing commenced, the last row should just go in. If the last row is too loose, 2 or 3 of the smaller apples should be replaced by slightly larger ones. This operation has decided the size of apple that is being packed, and it is the only way of securing a really tight and effective pack every time without fail. The first row decides the success of the pack, and if it is well packed in accordance with the method, no difficulty will be found in packing the other tiers.

It has been stated that 4 apples might go in and not 5, yet the 3-2 pack would not come right, because the second row might slip into the first. Should this occur, it is clear that an attempt is being made to pack apples which have already been sized, and the method of sizing at time of packing as described above has not been followed. As the whole system depends for its success upon this method, it is important that it should be made perfectly clear. To take an extreme case, let us suppose that the packer has selected 5 apples which are $2\frac{1}{2}$ in. in diameter one way, and $2\frac{1}{4}$ in. another. If they are placed the $2\frac{1}{2}$ in. way the fifth will not go in because 5 x $2\frac{1}{2}$ in. is $12\frac{1}{2}$ in., and the box is only $11\frac{1}{2}$ in. wide. If, however, they are placed the $2\frac{1}{4}$ in. way the 5 will go in easily. This merely shows that the average size is too small. If this has occurred and the apples in the second row will not hold their position, those particular apples should be rejected, and others very slightly larger chosen. The average size will then be large enough to pack 3-2. It has already been stated that the sizes must be chosen so that they will pack. The apples rejected will, if not too small for boxing, pack with the 3-3 pack.

The 3-2 Diagonal Pack.—Sizes coming under Rule 2 should be packed as follows: Select 3 apples as nearly the same size as possible; place one in each of the lower corners of the box, and the third midway between these two. In the two spaces thus made in front of these apples place 2 apples for the next row, choosing them and fitting them according to the previous paragraph. Then complete the rows with 3 and 2

apples alternately. Commence the second tier by placing 2 apples in the two spaces or pockets between the first 3 apples in the first tier, then place 3 and 2 alternately until the end of the box is reached. The third tier will commence with 3, the fourth with 2 and fifth with 3.

If care has been taken to observe the points mentioned, it is impossible for the pack to fail to come the right height.

The 2-2 Diagonal Pack.—One apple of any of the sizes ascertained by Rule 3 is placed in the left hand corner of the lower end of the box, and a second, as nearly the same size as possible is placed midway between the cheek of the first apple and the other side of the box. The second row is made by pressing one apple into the space between the first two apples, and the other in the space between the second apple and the side of the box. The rows are continued to the other end of the box in a similar manner.

The 2-1 Diagonal Pack.—One apple of any size ascertained by Rule 4 is placed in each of the lower corners of the box. The second row consists of one apple only of as nearly the same size as possible, which is placed in the space between the first two. The pack is then completed 2 and 1 alternately as already described.

The 3-3 Diagonal Pack.—One apple of one of the sizes indicated by Rule 1 is placed in the lower left hand corner of the box. In the space between that and the right hand corner, two apples of as nearly the same size as possible are placed, so that the three spaces left—two between the apples and one between the last apple and the side of the box—are equal. In these three spaces three similar apples are placed, and so on, always 3 apples in a row.

Nailing up the Box.—With the pack complete, and projecting about one inch above the box, the box is transferred to the nailing press, lining papers folded over, bottom boards put on, and pressed down carefully by the machine. This presses the apples carefully into place, where they are tightly held by the spring of the top and bottom boards. The bottom can then be nailed down, through cleats if these are used, without fear of splitting. The box is taken out of the press, turned upside down, for the reason already stated, and pencil marked with the name of the variety and count (or number of apples in the box) ready for labelling.

Further Points.—When the packer has gained experience, there are three further points which may be watched. (1) After

placing the first two rows, the rest may be packed diagonally. This is much quicker, but should not be attempted until the packer is able to keep his horizontal rows straight, and his pack tight.

(2) Wrapping papers may be used. This lessens risk of damage, prevents the spread of disease, gives an attractive appearance, and actually saves time in packing.

(3) During packing the apples may also be selected so that the size gradually increases towards the middle of the box, though the variation should not be so great as to be noticeable. This will give a natural bulge to the pack and will help to keep all tight. The importance of this bulge. however, can easily be overestimated, because with the diagonal pack, the pressing will naturally press the apples towards the middle of the box, if it is carefully done, and a bulge will thus be obtained.

Table of Packs and Sizes.

The number in the last column is used to indicate the size packed.

Pack.		Number of Apples in each Tier.	Number of Apples in Box.
2—1	2—1, 4—3	11, 10, 11	32
	2—1, 4—4	12	36
Diagonal	2—1, 5—4	14, 13, 14	41
	2—1, 5—5	15	45
3 Tiers.	2—1, 6—5	17, 16, 17	50
	2—2, 3—3	12	48
	2—2, 4—3	14	56
	2—1, 4—4	16	64
2—2	2—2, 5—4	18	72
	2—2, 5—5	20	80
Diagonal	2—2, 6—5	22	88
	2—2, 6—6	24	96
4 Tiers.	2—2, 7—6	26	104
	2—2, 7—7	28	112
	2—2, 8—7	30	120
	3—2, 5—4	23, 22, 23, 22, 23	113
	3—2, 5—5	25	125
3—2	3—2, 6—5	28, 27, 28, 27, 28	138
	3—2, 6—6	30	150
Diagonal	3—2, 7—6	33, 32, 33, 32, 33	163
	3—2, 7—7	35	175
5 Tiers.	3—2, 8—7	38, 37, 38, 37, 38	188
	3—2, 8—8	40	200
	3—2, 9—8	43, 42, 43, 42, 43	213
	3—2, 9—9	45	225
3—3	3—3, 6—6	36	216
Diagonal	3—3, 7—6	39	234
6 Tiers.	3—3, 7—7	42	252
	3—3, 8—7	45	270

Illustrations of all sizes when packed have frequently been published, and Figs. 1 to 3 together with the text may suffice to explain the whole system.

Examples of Position of Apples in First Tier.

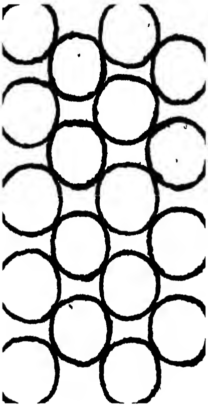


FIG. 1.—2-2, 5-4 pack.

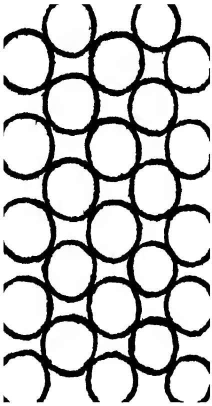


FIG. 2.—3-2, 5-5 pack.

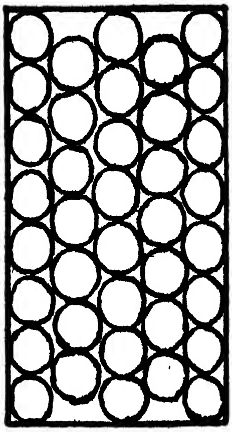


FIG. 3.—3-2, 8-7 pack.

The writer wishes gratefully to acknowledge that some of the ideas in this article were suggested by a perusal of bulletins issued by the Australasian and Canadian Government Departments.

IMPERIAL FRUIT SHOW.

As a result of visits paid in 1920 to the Commercial Fruit Shows held in the fruit-producing districts (Maidstone, Worcester, Wisbech), the impression was gained that while these shows served an extremely useful purpose in educating growers and stimulating individual efforts in the direction of producing superior fruit, there was a great need for co-ordinating the activities of the Societies concerned, (1) in order that the prize-winning exhibits at individual shows might have an opportunity of competing against each other, and (2) so that the public in the large towns of the country might be afforded an opportunity of seeing what an excellent standard of production is reached by British growers, and that they too might be educated and assisted in the selection of the varieties most suited for dessert and culinary purposes. The latter point is of great importance since the public need much convincing that British-grown fruit is really equal to the imported varieties of which they see so much during the greater part of the year.

The Horticulture Division of the Ministry gave very serious consideration to this matter and arrived at the conclusion that it was necessary, and should be possible, to arrange for a National Fruit Show to be held annually in one of the large cities, and that, if possible, the first of these Shows should be held in London. In the course of a speech made at Worcester, the Controller brought this suggestion before members of the industry, and subsequently a meeting was called to consider how it could best be carried into effect.

Before any definite conclusions were arrived at the matter was taken up by the *Daily Mail*, one of the Directors of which offered (provided that the trade would give adequate support) to organise the first show and to assume the financial responsibility of the undertaking. An Advisory Committee representing the Commercial Horticultural Industry of the British Empire was convened by the Ministry and agreed to co-operate on the basis that all matters of finance and general organisation in connection with the show were left to the *Daily Mail*, but that the decision of the Committee on technical matters should be given effect to.

It was on these conditions that all the several bodies co-operated to make it possible to hold an Imperial Fruit Show.

Work of Advisory Committee.—The Advisory Committee was constituted of representatives of the leading British Commercial Fruit Shows of Kent, Midlands and Eastern Counties, the Fruit

Commissioner for Canada (Ontario, British Columbia, Quebec and Nova Scotia), the Royal Horticultural Society, Chamber of Horticulture, Federation of British Growers, National Farmers' Union, Horticultural Trades' Association, National Federation of Fruit and Potato Trades' Association, National Federation of Retail Fruiterers and Florists, and the National Association of Cider Makers, with the Controller and Deputy Controller of Horticulture representing the Ministry.

The Provincial Show Committees mentioned below decided to give full support to the undertaking, and, this year, to make their annual shows integral parts of the Imperial Fruit Show, instead of holding them separately and in the provinces. The Committee, therefore, decided to devote a section each to the Kent Commercial Fruit Show, the East Anglian Commercial Fruit Show, and the West Midland Commercial Fruit Show. Each of these sections will be organised as in past years by their respective Show Committee. A further section has been arranged for apples from Overseas, and for this the Canadian Fruit Branch has agreed to act as agents in Canada. An Amateur Section will be reserved for apples grown in private gardens and allotments. Cider fruit has not been overlooked, and three classes for suitable apples have been included in the schedule; the National Association of Cider Makers and the National Cider Institute will organise this section. It will be seen, therefore, that the co-operation and support of all the Associations connected with the fruit industry have been obtained. There will be further classes open to the whole of the United Kingdom, and two classes open to all fruit growers or associations of fruit growers in any part of the British Empire. It is in these latter classes that the highly-coloured produce of British Columbia and Ontario will be seen in keen competition with the soberhued but more highly-flavoured apples grown in the Mother Country. There is no doubt that this competition will evoke considerable interest.

It is a matter for regret that the date of the Show will not permit of the competition of produce from South Africa, Australia and Tasmania, but it is not clear that any date could be selected to permit of competition of apples from all parts.

Education Exhibits.—In addition to the competitive classes specified above, provision will be made for exhibits dealing with the many phases of fruit-growing, and in this connection it is hoped that the Ministry will be able to stage a scientific exhibit dealing fully with grading and packing of apples, plant hygiene

and pest control. Exhibits demonstrating the results of recent research will probably be shown by the Research Stations of Long Ashton, East Malling, and Campden. Moreover, the Cider Makers Association have agreed to provide the money necessary to permit of a demonstration of cider-making being given daily during the exhibition by the Long Ashton Research Station under the direction of Professor Barker. Exhibits of traders interested in the horticultural industry will naturally find a place in the show. The Dominions will stage very attractive exhibits of fruit and will probably also arrange an attractive side-show of films dealing with fruit-growing.

Propaganda.—For the size of the population this country consumes far too little fruit, especially when it is realised that large masses of the population live in towns and lead sedentary lives. The general health of the nation would perhaps be much improved by an increased consumption of fruit. To promote this it is hoped to arrange for the co-operation of the Federation of British Growers, the National Federation of Fruit and Potato Trades' Association, and the National Federation of Retail Fruiterers, in the direction of convincing the public of the value of an increased consumption of home-grown fruit.

Place of the Show.—The Exhibition will be held at the Crystal Palace, between October 28th and November 5th. In many ways the Palace is well adapted for the purpose. It is easily accessible and contains abundant space for competitive and trade exhibits, as well as halls and club rooms for meetings, and a cinema theatre for film displays.

Conferences.—Horticulturists interested in apple growing and the fruit industry in general will come to the show for at least one day; and it is hoped that daily conferences will be arranged by various sections of the industry. One day will be given up for a discussion on grading and packing, and the manufacture and use of standard packages, and an attempt will be made to secure agreement on this question. Another day will be set aside for the discussion of insecticides and fungicides, and their use in controlling insect pests and plant diseases. The cider makers will probably also meet and discuss ways and means for popularising cider—particularly in the direction of using an official label as a guarantee of the quality of the beverage.

Popular addresses will also be given on such subjects as the apple tree, bud formation, and others.

THE WORKING OF A FEDERATION OF WOMEN'S INSTITUTES: DORSET.

BENITA LADY LEES.

WOMEN'S Institutes were started in three Dorset villages in the latter part of 1915, their formation then being more with the object, in a temporary way, of increasing the food supply, than of giving life to a far-reaching movement.

The amount of progress made through the Dorset Women's Institutes in home industries and generally in increasing knowledge affecting the home, garden, and field, has been far greater than was ever the case in any five years before the introduction of this movement into the country. Further developments may be anticipated, which should ultimately lead both to an improved rural education and to a higher efficiency among all country women. The simplicity of the movement at once appeals to all, and its stability is assured, its foundations being centred in the home—the national training ground for good citizenship. The three Institutes started in 1915 were for nearly two years the only ones in the county, but towards the middle of 1917 the Dorset Women's War Agricultural Committee undertook propaganda work, with the result that 18 further Institutes came into existence. Shortly afterwards a County Federation was formed. It is consoling to look back to the early days of the Federation and to know that in place of total ignorance of organisation on the part of the inexperienced officers, there is now a certain amount of order and system, and that the Institutes of to-day are out of all comparison better provided for and are working in closer co-operation than was the case in 1917.

A few details of the Dorset Organisation may be of interest, even if they be regarded merely as a milestone to show progress and how far off the goal still is. Among the members of the first Federation Committee were an "Organiser of Speakers" and an "Organiser of Industries"; the former of these offices still exists. A register of all local speakers and demonstrators is kept, and tours are arranged in connection with special subjects.

The office of Organiser of Industries soon had to be merged into a sub-committee having its own secretary, and excellent work has been done. The county is fortunate in having a flourishing and well-run Arts and Crafts Association, and its Secretary gives valuable assistance on the Handicrafts Sub-Committee of the Federation. The change in the title of this branch from "Industries" to

"Handicrafts" indicates a lesson learnt as to a national characteristic. The original idea was to encourage industries on commercial lines. The Institute was to turn out articles by the gross to provide the Institute with funds. The County Organiser was to be responsible for supplying raw material and for making contracts to supply "the trade" with the products of the various industries; she was supposed to compile a register of Home Industries in England and to keep in touch with like developments in other countries. Alas! in Dorset, at any rate, we did not like or understand undertaking contracts in our spare time, and, except in a few cases, we did not care to work up to standard. If we did make things the trade would take, we liked them to be sold in our own county at some shop where a relation could go and report as to their position in the window! By means of classes and showing at exhibitions, however, we still aim at making articles up to trade standard for orders, the object of exhibiting being more to obtain orders than to sell our exhibits bazaar fashion.

Meanwhile we work at the basis of this branch—the improving of each individual's work—and have widened our list of handicrafts to include several "home crafts." The English housewife has not a good name for thrift, but on the programme of any Dorset Women's Institute there are certain to be found demonstrations, lectures, or classes on a variety of home crafts. It almost seems as though thriftlessness is largely a product of the system of education in the past. Lessons in dressmaking, plain needlework, embroidery, millinery, dyeing, all branches of cookery, laundry work, upholstery, rugmaking, cobbling, and slipper and glovemaking, are asked for by nearly all, and the classes are always well attended and followed with much keenness. So great has the demand become for instruction in scientific cutting-out and dressmaking that we have had to ask the County Education Committee if it can provide an Instructor. The request for such classes was formerly not sufficient in Dorset to justify the employment of a teacher of dressmaking, but a change has come, even since the War. and is in no small way attributable to the study of home economics—one of the objects of the Women's Institute Movement. The passing of the phase for anything cheap and the incidence of the new desire for instruction is remarkable and noteworthy.

Naturally enough the county could not produce enough Instructors, for handicrafts of all kinds are in great demand. A very satisfactory fortnight of classes to train Instructors was

therefore arranged and managed by the Handicrafts Committee last year. The training was of course very elementary, but a beginning was made, and this year it is proposed to hold more advanced classes. Before qualifying as Instructors, the students, after six months in which to practice, had to enter their work for the Dorset Arts and Crafts Exhibition and obtain the Association's Green Star of Merit; thereafter they could be placed on the county's list of qualified teachers. There are in the county what may safely be described as three real industries run by three different Institutes which make and supply articles either retail or for large orders—soft toys, dolls, and sun-bonnets. Many other industries are coming on well, but do not yet turn out their products in large numbers.

The Hants and Dorset Stall at the Royal Counties Show at Bournemouth realised £140 for the 27 Women's Institutes that contributed 1,127 exhibits from our county. Those who were in charge of the stall testify to its value as propaganda for the movement, many enquiries having been made and information given, so that it is hoped to hear soon of still more villages wanting Institutes. This would mean that our Organisation Committee would be overwhelmed with work; this committee not only starts an Institute but until the Institute is strong—usually for some three or four months—provides speakers on Institute work so that it may be thoroughly clear on all points. It is only when an Institute has been thoroughly well started that it can be expected to do well, and to thoroughness we owe the fact that we have a strong Federation in Dorset, all Institutes, since the formation of the Organisation Committee, having been well grounded before becoming federated.

The Federation Council—one Delegate from each Women's Institute—meets twice yearly, in the winter for the business meeting when the year's Executive is elected, and in the summer, when a speaker on some such subject as the drama, music, or handicrafts, visits us, and some of our Institutes give exhibitions of folk dancing, singing, and other forms of entertainment.

Between these gatherings, group meetings are held; there are four Groups in the county and much useful work is done through them. Any member of a Women's Institute may attend, and the meetings help to give an example of the value of co-operation and to keep the Institutes from becoming parochial. At them the members arrange for such things as a joint pageant, or a speaker's tour, and as the numbers attending are naturally smaller than at the County Federation meetings, much informal

and useful discussion takes place. Difficulties are reviewed and very often overcome by help or advice from someone present. Last winter the Executive Committee arranged a week of Group meetings at which discussions, opened by various members of the County Executive, were held on the whole movement, local and national, and on the duties of committees, President, Treasurer and Secretary.

Several Institutes have benefited very materially by the County Council cheese classes, and at all the principal shows in the county the Federation is offering prizes to its members for cheese, butter, eggs and trussed fowls. Through a Sub-Committee the Federation is endeavouring to establish simple co-operative schemes for dealing with all agricultural and horticultural matters. One Institute last autumn formed a horticultural committee of men and women and bought £120 worth of seed potatoes wholesale. Co-operation is probably a difficult subject for amateurs owing to the lack of brief published statements on the subject. Country people have done without co-operative schemes for many generations and do not wish to be troubled with deep reading or experiments. Interest may attach to the outstanding doings of a few Institutes. Several Institutes have formed clubs for coal, clothing, blankets, etc., while cycling and games clubs provide excellent forms of recreation for the younger members. One Institute has established a penny bank for the children; another has started a club room for all the women of the village and is doing very well. Outfits of various useful kinds are to be found in several, boot repairing lasts, sweeps' brushes, vacuum cleaners, etc., being shared by the members. Lectures by qualified persons on such subjects as the care of the sick, home nursing, and invalid cookery, the prevention of illness, care of the teeth, baby welfare, and so forth, are frequently given. Considerable interest is taken in the Education Act, and its provisions are now known in a number of villages where there are Institutes. A feature not to be overlooked is the help many Institutes have given with the starting of a Men's Club in their village; one Institute did so much that it was entertained by the Men's Club in appreciation of its efforts immediately the hall was erected!

For the benefit of those who do not know the inner working of Institutes it may be stated that every Institute is governed by its members; it is worked by everyone and not by a few, and the programmes, of which each member has a copy, are drawn up for six or twelve months by the elected committee from sugges-

tions made verbally or taken from slips which members post in the Institute's suggestion box. Items on the programmes are there by express wish of the members and not because an influential section thinks it "good" for the members to have lectures on certain subjects. Any programme, therefore, may be regarded as a mirror of the character, aspirations and level of education attained by each village with an Institute.

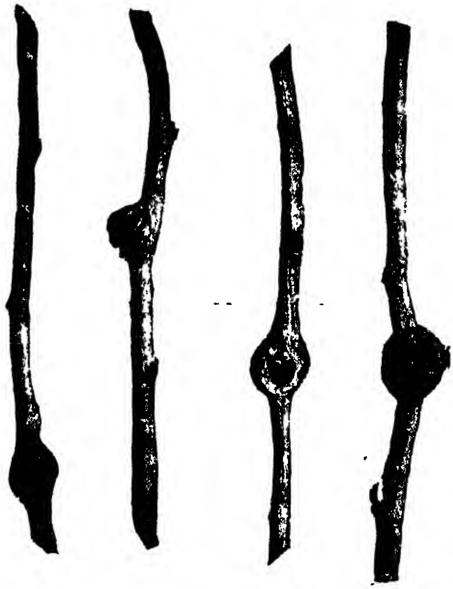
In dealing with Institutes in Dorset the movement and its progress have been considered as a whole; accounts of the everyday activities of Women's Institutes are commonly published in the local papers of nearly every county. Should details at any time be wanted, the headquarters, The National Federation of Women's Institutes at 26, Eccleston Street, S.W.1, will always be pleased to supply full particulars.

THE RASPBERRY GALL FLY.

(*Lasioptera Rubi*, Schrk.)

HERBERT W. MILES, N.D.A., Dip. Agr. Hons.
(Harper-Adams.)

THIS fly, which is one of the *Cecidomyidæ*, causes galls on the raspberry and blackberry, and is frequently met with in hedges and occasionally in plantations. Theobald (*Insect Pests of Fruit*, 1909), states: "It has seldom been brought to my notice as occurring in any amount on raspberries, and can scarcely be looked upon as a pest." In the Report on the Occurrence of Insect Pests, issued by the Board of Agriculture in 1918, the occurrence of abnormally large galls on the raspberry is mentioned, whilst in the Monthly Reports for January and February, 1921, issued by the Ministry of Agriculture, Theobald records



Galls on Raspberry Canes.

this pest as becoming increasingly injurious in Kent; it was also observed in Somerset during the winter of 1920-21, when the galls illustrated above were collected.

The galls on the canes are observed most readily after the leaves have fallen. They are located either at a node or in the internode, and measure from .59 in. to .79 in. ($\frac{1}{2}$ in. to $\frac{3}{4}$ in.) in length and up to .59 in. ($\frac{1}{2}$ in.) in width, and tend to be more regular in outline than the galls on the blackberry. If the galls

are opened they are found to be infested with numbers of larvæ, the usual number varying from fifteen to twenty, though as many as thirty have been recorded. The interior of the gall varies in colour from very dark blue to black, the centre being quite spongy in texture. The larvæ are readily seen, their orange-red colour making them very distinct against the dark interior.

The Larva is maggot-like and measures up to .1 in. ($\frac{1}{10}$ in.) in length at maturity. Feeding goes on through the late summer, autumn and winter. Where galled shoots were placed with their bases in water the larvæ became restless and commenced leaving the galls; they settled down quite normally, however, when the shoots were removed and placed in the soil, where the water supply was more in keeping with their natural requirements.

The Pupa is about .08 in. ($\frac{2}{25}$ in.) long and of the same colour as the larva. Pupation takes place in March and April in the galls, and before emergence the pupæ work themselves to the outside of the galls. After the exit of the flies the pupal cases may be seen protruding from one-half to three-quarters of their length out of the gall. Flies reared from galls kept at Long Ashton emerged between 13th April and the end of that month. Theobald, however, states that the flies hatch from May on into June. This difference is undoubtedly accounted for by the forcing effect of laboratory conditions.

The Adult is typical of the Cecidomyidæ. Its body, wings and limbs are covered with soft pubescence, and the dorsal surface of the abdomen is banded alternately with black and white, the pubescence on the ventral surface being uniformly black. The articulations of the wings and the coxal joints of the legs are yellowish in colour. The front of the thorax, which is almost hoodlike, is sparsely covered with rather coarse, almost bristle-like, greyish or yellowish down. The head is small and appears tucked under the thorax, and bears short, black antennæ, which are generally pointing downwards and forwards. The wing expanse is approximately .2 in. ($\frac{1}{5}$ in.).

Egg-Laying.—According to Theobald, egg-laying takes place in June, the eggs being deposited at the base of the buds and side shoots. They hatch in about eight days and give rise to larvæ which burrow into the rind and feed, setting up the irritation which results in the formation of the galls. The effect of infestation is a stunting of the canes, which may bear no fruit and few leaves.

Prevention and Remedy.—The fact that the galls can be seen in about six weeks after invasion by the larvæ suggests a simple method of dealing with this pest. A systematic search should be made through the plantations during autumn and early winter, and all galled canes should be cut off below the gall, and the prunings collected and burned, thus effectively destroying the larvæ.

As this gall fly also attacks the bramble, all blackberry bushes in hedges or in clumps near plantations should be cut back, and if it is definitely known that they are the source of infestation they should be destroyed by burning. In this way the pest can be satisfactorily controlled and plantations kept practically free from invasion.

THIRD INTERNATIONAL CONGRESS ON SEED TESTING AT COPENHAGEN.

C. B. SAUNDERS.

Director of the Official Seed Testing Station.

THE following notes on the Third International Seed Testing Conference are complementary to the account published in the July number of this *Journal* (p. 296).

The two previous meetings of the Congress were held at Hamburg (1906) and at Wageningen (1910). The third Congress was the outcome of a suggestion that the jubilee of the Danish Official Seed Testing Station would be a suitable occasion for another conference.

Invitations were sent by the Danish Government to the different countries possessing Official Seed Testing Stations, with the result that about thirty delegates were sent by the following countries:—Belgium, Canada, Czecho-Slovakia, Denmark, Finland, France, Germany, Great Britain, Holland, Hungary, Norway, Poland, Rumania, Servia, Sweden and Switzerland.

The Congress was held under the chairmanship of Professor Dr. W. Johannsen, who is the Chairman of the Danish State Seed Testing Board. The success of the meetings was largely due to Dr. Johannsen's personality and also to his ability to give a précis of any paper in almost any European language.

Papers were read during the week by the following gentlemen, and in most cases were followed by open discussion.

Mr. F. F. Bruijning (Holland): "General Views concerning International Unification of Methods of Seed Testing in the Interest of Trade, more especially with regard to the Purity of Seeds."

Dr. Volkart (Switzerland): "Determinations of the Provenance of Seeds."

Sir Lawrence Weaver: (*a*) "The Seeds Act, 1920."
(*b*) "The National Institute of Agricultural Botany."

Mr. C. B. Saunders: "Methods of Seed Testing in the United Kingdom."

Dr. Edgar Brown (America) (by proxy): "Seed Testing in the United States."

Mr. G. H. Clark (Canada): "Seed Control in Canada."

Prof. Dr. Voigt (Germany): "Investigations on the Germination of Grass, Clover, and other Small Grained Seeds."

Mr. L. Kommers (Germany) (by proxy): "Analysis of the Seed of the Beet Family."

Mr. J. Widen (Sweden): "Investigations on the Content of Water and on the Germination of Cereals."

Mr. Dorph-Petersen Denmark): "Report on the Investigations made by the State Seed Testing Stations, both in the Laboratory and in the Field, upon the Germinating Energy, Purity of Strain, and Freedom from Disease of Seed."

Mr. E. Vitek (Czecho-Slovakia): "The Determination of Dodder."

Dr. von Degen (Hungary) and M. Bussard (France): "Plans for the Unification of Seed Testing Methods."

Mr. Bruijning's paper was mainly concerned with a discussion of the various methods of making purity determinations. He pointed out the desirability, more particularly from the point of view of the seed trade, of standardising the methods by which such tests are made. A suggestion made for "grading" seeds according to a formula somewhat similar to the "real value" formula did not receive much support. Attention was also drawn to the question of "sprouted" seed. Mr. Bruijning pointed out that in many cases, particularly with cereals, "sprouted" seed was capable of making a satisfactory second growth, but the general feeling of the Congress appeared to be that it was desirable to look upon "sprouted" seed as an impurity.

Dr. Volkart dealt with the use of "character seeds" as a means of identifying the country of origin of the sample. He also pointed out that other impurities, such as earth, snail-shells, and other forms of inert matter were also of value in certain cases. It was suggested that one of the Official Seed Testing Stations should be asked to correlate all the available information on this subject, and also to collect further data from different parts of the world. At the request of the Congress Dr. Volkart undertook to do this work at Zürich.

The next four papers dealt mainly with methods of Seed Testing and Seed Control in different countries.

Sir Lawrence Weaver described the steps that led up to the passing of the Seeds Act and to the formation of the National Institute of Agricultural Botany. Mr. Saunders gave a summary of the Seeds Act Regulations and a brief description of the methods of testing used in the United Kingdom. Apart from the difference between the "Irish" and "Continental" methods of grass seed testing there is not much variation in technical details. In one point of routine work, however, the English Station appears to have gone further than the Continental Stations. Here the work is divided into four sections—Clovers, Grasses, Cereals, Roots and Vegetables—each having its own purity and germination rooms, whereas most of the Continental Stations do not make this differentiation. The English method would appear to have many advantages.

Dr. Voigt's paper was a plea for uniformity in methods of making germination tests, and the Congress accepted a number of general directions for use in making germination tests. These matters and also those raised by Mr. Bruijning were referred to the sub-committee mentioned in the note in the July issue of this *Journal*.

Mr. Widen's paper gave rise to a very useful discussion upon the difficulties that arise in connection with the germination of cereals immediately after harvest. Various forms of artificial stimulus were described, such as drying, freezing, clipping and so forth. The general opinion was that such methods were justifiable in that they gave a better impression of the agricultural value of the seed, but that in reporting such germination figures to the sender, the fact that some form of pre-germination treatment had been used should be noted.

Mr. Dorph-Petersen described the field tests which are being made by the Danish Official Seed Testing Station in connection with purity of strain and freedom from disease. Special attention so far has been given to barley and its associated diseases, particularly *Pleospora graminea*.

Mr. Vitek opened a discussion upon the occurrence of dodder in Southern Europe, and great interest was created by a demonstration by Dr. von Degen of a possible new method for the removal of dodder seed from clover. This is based upon the difference in the elasticity of the seed coats of the two kinds of seed, and can be demonstrated very simply. If red clover and dodder seeds are dropped one by one from a height of about eighteen inches into an ordinary saucer, it will be found that the red clover seeds almost all bounce out of the saucer, whereas the dodder seeds, being less resilient, remain in the saucer. So far, however, owing to various practical difficulties it has been found impossible to evolve a machine based on this principle.

The last paper on the list was an echo of the previous Congress, and the questions raised were submitted to the subcommittee.

NOTES ON FEEDING STUFFS FOR SEPTEMBER.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.).
Ministry of Agriculture and Fisheries.

IF the experience of past dry years repeats itself, the break in the dry weather will be followed by a luxuriant lushy growth of grass in the pastures, and the cattle will show a tendency to scour. This tendency can be corrected by the addition of a little cotton cake.

Oats have been an extraordinarily cheap feeding stuff, so much so that they have compared favourably with other concentrated feeding stuffs, and it has paid the farmer to buy in oats as a feed for his stock in preference to other feeding stuffs. It may be of interest here to emphasise the fact that, when conditions of price allow its use, a mixture of oats and linseed cake, half-and-half, forms one of the best feeds for the production of milk of which the writer is aware.

Home-grown Feeding Stuffs: the Future.—The unfavourable climatic conditions of this season will almost certainly result in a general shortage of home-grown food for stock in the spring and early summer of 1922. The hay crop has been got in under very favourable conditions, and has resulted in a light but very good quality hay. In some districts straw is also short, and owing to the dry weather, roots are also likely to be short except on a few well-favoured farms. In order to compensate for this possible shortage of food, it will be wise to reserve a break for the growth of a forage crop to come into use at the time that the question of feed will most likely be a problem. A vetches and oats mixture and winter cabbages may be suggested as suitable crops for this purpose.

Sweet Clover as a Forage Crop.—The attention of the writer has been called to the value of sweet clover (*Melilotus alba*) as a forage crop. In England its use has hitherto been confined to ploughing in as a green manure, but Canadian experience has established it firmly as an efficient substitute for clover in the rotation. In feeding value it is approximately equal to clover, and since it yields 5 tons of hay to the acre, it is too valuable a

NAME.	Price.		Price per Ton.		Manurial Value per Ton.		Food Value per Ton.		Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£	s.	£	s.	£	s.		s.	d.
Barley, English Feeding	45/6	400	12	15	1	6	11	9	71	3/3	1·74
„ Canadian „	49/-	400	13	14	1	6	12	8	71	3/6	1·87
Oats, English „	39/-	336	13	0	1	9	11	11	59·5	3/10	2·05
„ Foreign „	34/6	320	12	1	1	9	10	12	59·5	3/7	1·92
Maize, Argentine	48/6	480	11	6	1	5	10	1	81	2/6	1·34
Beans, English spring	—	—	—		—		—		—	—	—
„ „ winter	55/6	532	11	14	3	1	8	13	66	2/7	1·38
„ Rangoon	12/-	112	12	0*	3	1	8	19	66	2/8	1·43
Peas, English blue	60/-	504	13	7	2	13	10	14	69	3/1	1·65
„ „ dun	75/-	504	16	13	2	13	14	0	69	4/1	2·19
„ „ maple	92/6	504	20	11	2	13	17	18	69	5/2	2·77
Buckwheat	—	—	—		—		—		—	—	—
Rye, English	57/3	480	13	7	1	8	11	19	72	3/4	1·78
Millers' offals—Bran	—	—	10	0	2	10	7	10	45	3/4	1·78
„ „ Coarse middlings	—	—	15	15	2	10	13	5	64	4/2	2·23
Barley meal	—	—	16	5	1	6	14	19	71	4/2	2·23
Maize „	—	—	12	12	1	5	11	7	81	2/10	1·52
Fish „	—	—	19	0	7	12	11	8	53	4/4	2·32
Linseed	—	—	24	10	2	16	21	14	119	3/8	1·96
„ Cake, English	—	—	17	9	3	12	13	17	74	3/9	2·01
Cotton seed „ „	—	—	11	15	3	5	8	10	42	4/-	2·14
„ „ decorticated	—	—	15	10*	5	6	10	4	71	2/10	1·52
„ Meal, decorticated	—	—	15	15*	5	6	10	9	71	2/11	1·56
Coconut cake	—	—	12	15	3	0	9	15	79	2/6	1·34
Groundnut cake	—	—	—		—		—		—	—	—
Palm kernel cake	—	—	10	15*	2	1	8	14	75	2/4	1·25
Brewers' grains, dried, ale	—	—	9	15	2	7	7	8	49	3/-	1·61
„ „ wet „	—	—	1	13	0	12	1	1	15	1/5	0·76
Distillers' „ dried	—	—	9	7*	2	16	6	11	57	2/3	1·20
Malt culms	—	—	8	0	3	6	4	14	43	2/2	1·16
Potatoes †	—	—	2	13	0	8	2	5	18	2/6	1·34
Swedes †	—	—	1	2	0	5	0	17	7	2/6	1·34
Mangolds †	—	—	1	1	0	6	0	15	6	2/6	1·34
Vetch and Oat Silage †	—	—	2	10	0	15	1	15	14	2/6	1·34

* Prices at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

fodder crop to neglect, if stock can be got to like it. English experience has rejected the use of this crop in the past owing to the presence of a bitter principle "cumarin," which is chiefly present in the stems. The chief point in cutting or grazing this crop is therefore to cut the crop before it gets too woody. If the stock are turned on to this feeding stuff early in the spring before other green stuff is available they will soon learn to relish it. Owing to its erect habit of growth, sweet clover would probably be a suitable crop to sow with vetches as a supporting crop.

Prices of Fertilisers.

THERE has been a steady decline in the prices of nearly all fertilisers during the past few months. In no case has the drop been more marked than in that of *sulphate of ammonia*, the price of which has almost fallen to pre-war level. For sulphate containing 25¾ per cent. of ammonia (neutral quality) the price for May delivery was £26 0s. 6d. per ton as compared with the present price of £14 6s. For 25¼ per cent. ammonia (ordinary quality) the May price was £25 2s., and for 24¾ per cent., £24 11s.; these prices have now dropped to £13 3s. and £12 17s. respectively. A noticeable feature of the export market for sulphate of ammonia is the revival of the trade with Japan, which for a considerable period was practically dormant.

While the prices for the higher grades of *basic slag* are practically at the same level as in May, the prices of the lower grades, for which the demand is much smaller, have fallen considerably, basic slag of the 20-22 per cent. grade being now sold at 80s. per ton instead of 113s. 6d., which was the price for May delivery.

Superphosphate also shows a decline in price, being now sold at £5 15s. per ton for 30 per cent. superphosphate as against £8 5s. in June. Owing principally to the cheaper supplies obtainable in other countries, the export market for superphosphate has fallen off considerably, thus leaving large stocks in hand to meet home requirements.

Nitrate of soda has fallen from a May price of £19 7s. 6d. per ton to £18 10s. at the present time.

In keeping with the general fall in prices, both French and German *potash salts* may now be obtained at almost half the prices ruling last March. The prices mentioned above naturally vary somewhat in different districts, and apply only to substantial quantities, *i.e.*, 2 or 4 ton lots, usually free on rail.

DURING the past few months there has been a notable fall in the market values of practically all descriptions of live stock.

The Fall in Live Stock Prices. The decontrol of fat stock at the beginning of July, 1920, was followed by an immediate and substantial advance in prices, and although a reaction set in almost at once, throughout the year prices for the better grades of cattle, and for all descriptions of sheep, remained considerably higher than those which had been in force under control. Fat cattle normally decline in value between July and October, and 1920 was no exception to this rule, but the Christmas demand forced prices up to a higher point than had been reached at any time previously, and although a slight decline set in subsequently, the December level of prices was fairly well maintained up to the end of April. Fat sheep showed a steady advance in price, after the first violent fluctuations succeeding decontrol; this advance was checked in December, probably owing to the Christmas demand for beef in preference to mutton, but trade in the best quality fat sheep recovered during January, although the lower grades continued the slight downward movement commenced at the end of November. During the first four months of 1921 fat sheep steadily declined in value, the decline being no doubt due in some measure to the continuous fall in the market value of wool.

Table I shows the average market prices of fat cattle and sheep under control and during January and April of this year.

TABLE I.

Average Market Prices of Fat Cattte and Sheep in certain months of 1920 and 1921.

	June, 1920.		January, 1921.		April, 1921.	
	s.	d.	s.	d.	s.	d.
Fat Cattle (per live cwt.)—						
1st Quality	95	0	105	9	104	9
3rd Quality	85	0	85	0	82	9
Fat Cows	90	0	93	3	90	9
Fat Sheep (per lb.)—						
1st Quality	1	6½*	2	2†	2	0¾†
3rd Quality .. .	1	6¼*	1	8¼†	1	5½†

* Shorn. † In wool.

Since the beginning of May the decline has been much more rapid and became accelerated during July, although a slight recovery has been noticeable during recent weeks. Table II shows the average market prices of fat cattle and sheep during the fifteen weeks up to the week ending August 17th.

TABLE II.

Weekly average Market Prices of Fat Cattle and Sheep, 1921.

Week ending	Fat Cattle (per live cwt.).						Fat Sheep (shorn) per lb.	
	1st Qual.		3rd Qual.		Cows.		1st Qual.	3rd Qual.
	s.	d.	s.	d.	s.	d.	d.	d.
11th May	101	9	81	0	87	9	20½	15
18th "	101	9	78	6	88	3	20¼	15¼
25th "	101	6	76	6	87	9	20¾	14½
1st June	98	6	75	0	83	3	21	15¼
8th "	95	9	72	0	81	6	20¼	14½
15th "	95	9	71	6	81	0	19¾	14¼
22nd "	93	6	69	9	78	0	18¾	13¼
29th "	88	6	66	6	73	0	18¼	12¾
6th July	87	9	67	3	73	3	18	12½
13th "	83	0	61	0	66	3	16¾	11¼
20th "	79	6	59	0	63	6	16¼	11
27th "	82	0	60	6	65	0	16¾	11½
3rd August ...	83	0	63	3	66	9	17	11¾
10th " ...	85	0	61	3	67	9	17¾	12
17th "	84	0	62	3	67	3	17	11½

Since April fat cattle have thus fallen by 20 to 26 per cent., while sheep have declined 18 to 23 per cent. compared with May, when shorn sheep were first marketed in appreciable numbers. Many factors have no doubt contributed towards this decline. A slight fall in prices is a normal feature of this season of the year, but it is not usually sufficiently noticeable to attract attention, and has probably been accentuated this year by the abnormal conditions that have obtained, industrially and climatically, during the past few months. The continued drought and consequent lack of keep have resulted in larger numbers of fat stock being marketed than is normally the case at this season of the year, and many of the animals sent into the markets have been in only a partly finished condition. Add to this the reduced demand consequent upon a long spell of hot weather, and an abnormal amount of unemployment, and there is no cause for wonder that trade and prices have been seriously disturbed.

These factors, however, are not sufficient in themselves to account altogether for the heavy decline in prices which has occurred. The primary cause of the fall is more probably the general decline in wholesale prices which has recently become apparent, and which has already been reflected in the market values of other agricultural produce. Table III shows the index numbers of wholesale prices during the past year, as given in the *Statist* newspaper (expressed as percentages of the index number for 1913), together with the index numbers of agricultural prices during the same period and those of the cost of living prepared by the Ministry of Labour.

TABLE III.

Index Numbers of Prices.

Month.	*Statist* Wholesale Prices* (1913 = 100).	Cost of Living* (June, 1914 = 100).	Agricultural Produce† (1911-13 = 100).
July, 1920 ...	299	255	274
August ,, ...	298	261	277
September ,, ...	293	264	281
October ,, ...	282	276	291
November ,, ...	263	269	297
December ,, ...	244	265	294
January, 1921 ...	230	251	286
February ,, ...	215	241	272
March ,, ...	208	233	258
April ,, ...	200	228	241
May ,, ..	191	219	212
June ,, ...	183	219	202
July ,, ...	186	222	200

*End of month prices. †Monthly average prices.

Wholesale prices have thus fallen by nearly 40 per cent. since July last year, while agricultural produce of all kinds, which had in November risen to a point 197 per cent. above the pre-war level, has since fallen to 141 per cent. in April and 100 per cent. in July, above the average for 1911-13. The reduction in fat stock values may therefore be set down to a general re-adjustment of prices rather than to any other cause, and bearing in mind the extent to which other produce has fallen, it is matter for comment rather that prices of live stock were maintained for so long than that they have now commenced to fall.

* * * * * *

International Potato Conference.

IN order to secure the full discussion of the manifold and complex problems with which breeders and growers of potatoes are confronted, the Ministry and the Royal Horticultural Society have arranged to hold jointly an International Potato Conference in London from 16th to 18th November next, at the Royal Horticultural Society's Hall, Vincent Square. During the progress of the Conference the National Potato Society will hold its Annual Show in the Hall, and most British varieties of potatoes will be exhibited. In addition an exhibit dealing with the scientific aspect is being arranged, and it is hoped that workers engaged on potato problems in all parts of the world will co-operate.

Invitations to the Conference have been extended by His Majesty's Government to the Governments of the Dominions and Colonies, and of Foreign Countries, and it is hoped that it will be a representative gathering of all those interested in the

question, whether from the scientific or commercial point of view. Arrangements for the Conference are being made under the direction of a Committee constituted as follows:—

Chairman—LORD LAMBOURNE, C.V.O., Royal Horticultural Society.

Vice-Chairman—SIR DANIEL HALL, K.C.B., Ministry of Agriculture.

F. J. CHITTENDEN, W. CUTHBERTSON, C. G. A. NIX, MARTIN H. SUTTON — Royal Horticultural Society.

A. D. COTTON, P. G. DALLINGER, W. G. LOBJOIT — Ministry of Agriculture.

JAMES WOOD, Board of Agriculture for Scotland.

J. R. CAMPBELL, Department of Agriculture, Ireland.

WILFRED PARKER, National Institute of Agricultural Botany.

J. R. POAD, W. H. MORTER — National Potato Society.

Joint Secretaries — W. R. DYKES, Royal Horticultural Society. H. V. TAYLOR, Ministry of Agriculture.

The programme of the Conference covers the breeding and selection of potatoes, industrial and commercial uses, the potato industry, and various diseases to which potatoes are subject.

* * * * * *

Manuring for Meat and Milk.

ISSUED by the Ministry as Miscellaneous Publication No. 30, Professor Somerville's latest summary of the experiments conducted for the improvement of pasture, links together in a simple and most interesting fashion the results obtained from a wide number of centres. The oldest of these, Cockle Park, has had its experiments in existence for about a quarter of a century. The variety of conditions and soils, together with the periods during which the various tests have been conducted, add to the value of the results. The experiments were commenced at a time when basic slag was beginning to command attention as a means of improving pastures. From the commencement of the trials it has been compared with lime, bones, and superphosphate—traditional dressings twenty-five years ago. There was, and still is, the belief that cake must be fed if, on much of our grassland, stock are to be properly finished. All these methods were included in the experiments from the first, together with tests of phosphates with potash on the one hand, and with nitrogen on the other. The original trials commenced on such lines, and many centres have duplicated them, wholly or in part, while tests at other centres also help to furnish the conclusions arrived at by Professor Somerville

It is clear that phosphates are the foundation of all improvement of pasture in this country. Their effect is now well known amongst farmers. They stimulate the clovers and other *Leguminosæ*. A season or two after the application of basic slag, a poor pasture is commonly found to be a carpet of clover. Leguminous plants are nitrogen-collectors, and the result is that the soil is enriched and the grasses in turn are nourished to a new luxuriance. The improvement is continued in the increase of the better pasture grasses, and the suppression of coarser and inferior plants, whether grasses or weeds.

Of the phosphatic manures, slag has proved superior to superphosphate or dissolved bones. Professor Somerville is of opinion that precipitated phosphate and raw mineral phosphates ground very fine are worth trying. Much of our poorer pasture land is sour or acid, and the growth of clovers is stunted. Their development, as has been shown, is an essential step in the advance towards improvement. On account of its alkaline character, slag tends to counteract soil acidity, whereas superphosphate is acid and therefore likely to intensify the trouble. Superphosphate with lime is often mentioned as an alternative to slag. They have been tested side by side. In the first nine years of the Cockle Park tests the total liveweight increases resulting from the two dressings approximated very closely, but the net gain each year, after the manures had been paid for, showed a bigger balance from the plot treated with slag.

Lime alone does not appear to be an important agent in the improvement of all pastures. At three centres, as widely apart as Northumberland, Northamptonshire and Hampshire, its use alone continued to show a loss even after eight years. Its value is on pastures with a tough fibrous top, which it breaks down, and so prepares the way for phosphates. The condition of such pastures may be due to situation or may result from unsuitable manuring. Potash seems to be necessary in only very few instances, but nitrogen applied in any form is most unsuitable. One way in which nitrogen may thus be brought to the pasture is in feeding cake to the stock. Professor Somerville shows that cake alone gives a disappointing return both directly in the liveweight increases due to its use, and indirectly when an improvement consequent on the manurial residues is looked for. With regard to caking stock on slagged pasture he says: "The worst possible conditions for the use of cake are when it is supplied to animals grazing land which itself has been improved by slag."

Slag may be applied to pasture at any time of year. The practical advantages of summer dressing are evident in the matter of carting, labour, and calm days for drilling. The effect is lasting, but fertility should be maintained at a high level by further doses at periods of three or four years. Nothing so striking as the first improvement is likely to be observed after subsequent dressings, but the standard of fertility being higher, contrast cannot be so obvious. Slag prolongs the grazing season. The presence of clovers is necessary, as they are an essential link in the chain of improvement. Where they are absent or almost so, wild white clover seed should be sown, and Professor Somerville urges farmers to grow their own. It is interesting to see confirmed the natural conclusion that if slag results in live weight increase it will also affect greater yields of milk.

The application of nitrogen, it is insisted, is bad for pasture. The reason for this is that it encourages the growth of coarse grasses and weeds which in turn crowd out the finer herbage. The latter is more palatable and of higher feeding value. Nitrogen thus applied depresses clovers. The whole series of results is the opposite to that brought about by phosphates. In respect of these facts, meadowland is broadly the same as pasture. That quantity is not the same as quality in meadow hay is clearly brought out by the figures given. The influence of potash is worth noting. In the experiments quoted it actually reduced the yield when used alone, whereas applied along with phosphates it considerably improved the quality of the hay.

* * * * * *

Labelling English Honey.

IT has come to the Ministry's notice that a certain amount of imported honey at present on the English market is of a quality inferior to that produced in this country. Some of it has been used for bee-feeding during the winter months, with very unsatisfactory results. Apart from this aspect of the matter, consumers of honey should support home industry by asking for English honey, and thus not only stimulate the production of this valuable food commodity, but also induce producers to use a distinctive label showing that the honey is home-produced. Such labels are now being issued by most County Bee-Keepers' Associations to members who ask for them, but many do not yet fully recognise their value. This is, perhaps, not to be wondered at, since bee-keepers are primarily producers and not salesmen. The labels used by some County Associations state that complaints as to the quality of the honey should be

made to the Associations. As a matter of fact, an Association, by the issue of a label, does, in effect, guarantee the contents of the jar or section of comb-honey on which the label is used as "pure English honey," and if the contents were found to be not of that description, severe steps would no doubt be taken by the Association against the offender.

The Ministry advises all members of Associations to take full advantage of the issue of labels and to use them in presenting their supplies to public or private customers. The use of the label should also ensure that English produce is kept up to a high standard. There are at the present time no powers under the Merchandise Marks Act which enables the Government to insist on the marking of imported honey as such and as coming from a stated country.

* * * * * *

Improvement of Grassland.

THE Ministry has been active in arranging a series of lectures on, and in bringing about demonstrations of, the methods of improving grasslands over the country. The County Agricultural Education Authorities and the Agricultural Colleges have readily come to the Ministry's assistance, and at some 339 centres in England demonstrations are now going on. The Ministry is publishing a series of County guides to the demonstrations, and those for Derbyshire, Shropshire, Kent, East Sussex, Wiltshire, Lindsey, Kesteven, Surrey, Somerset, Notts. Cornwall, Stafford, Gloucester, Warwick, East Suffolk, Northampton, Buckingham, Leicester and Dorset have already been issued. Copies may be had in each case from the Agricultural Organiser of the county concerned. His address is usually the County Council Offices. Guides to demonstrations in Cheshire, Cumberland and Westmorland, Yorkshire and Rutland are now in preparation. All farmers interested in the matter should get their County guide and visit the demonstrations nearest to their holding. They will find that a personal inquiry into the ways and means of improvement will be of very great value indeed, in many cases, in helping them to improve their meadow and pasture land. In the present season lectures are being held throughout the country by Professor Gilchrist, of Armstrong College, by Dr. J. Hanley, of Leeds University, and by Professor Stapledon and Mr. T. J. Jenkin, of University College of Wales, Aberystwyth.

In June, 1921, there were in England and Wales no fewer than 14½ million acres of permanent grass and 11½ million acres of

arable land, of which 2½ million were under temporary grasses (clovers, sainfoin, and rotation grasses) and in addition there were 4½ million acres of mountain and heath land used for grazing. The total acreage of grassland of one kind or another in England and Wales in June, 1921, was, therefore, about 21½ million acres, compared with about 9 million acres under other crops. It is, however, not merely the extent of the grassland that renders attention to the matter urgent. There is the very important additional consideration that a large proportion of it is of very poor character and capable of considerable improvement. Farmers in general are making much more use of improved methods of growing ordinary crops than of those of cultivating grasses. The grasslands are therefore getting very much behind in farming economy, and farmers should consider how improvement as exemplified by the demonstrations can best be effected. There are cases where the produce of grassland has been trebled and quadrupled, and in one experiment (at Cockle Park, Northumberland), by suitable treatment the produce has been raised from 20 lb. of lean meat per acre per annum to 105 lb., giving more than a five-fold increase in value. There is doubtless much still remaining to be learnt by the instructors on the subject, and much research has still to be made, but there is also much knowledge which has already been accumulated and which should be known without further delay by all sections of the farming community.

New Seeds Regulations.

ATTENTION is particularly directed to three matters in connection with seeds administration which will affect the working arrangements of seed merchants.

a.—The first and most important is the provision in the Seeds Regulations, 1921,* which has a bearing on the validity of certificates issued by an Official Seed Testing Station or by a licensed station. Under Regulation (5) a test on which a declaration is to be based *must* be made upon a sample of a certain weight. A test made on an underweight sample will not be valid for this purpose.

It has been decided that in all cases where a sample of less than the scheduled weight is received by the Official Seed Testing Station, the sender shall be required to forward a *fresh full-weight sample*, unless the original underweight sample is accompanied by a statement that the certificate is not required for sale

* See this *Journal*, Vol. XXVIII., p. 370.

purposes. It was felt that this course would be preferable to the alternative of issuing a certificate which would be valueless for commercial purposes and which would carry no legal weight.

In practice, samples will be weighed immediately they are received at the Official Seed Testing Station, and senders of underweight samples, in the absence of the above-mentioned statement, will be advised by letter that fresh samples of full weight are required. The station will not undertake to mix two underweight samples to make one sample of full weight, but will return the original underweight sample on request.

b.—The second point is that the Official Seed Testing Station will be transferred to Cambridge early in September, and that after the date of transfer, of which notification will be given in the Press, samples should be addressed to the Official Seed Testing Station for England and Wales, Huntingdon Road, Cambridge.

c.—The third point is that from the date of transfer of the station to Cambridge, the privilege of franked correspondence will be withdrawn. All letters, parcels of samples, etc., posted to the station at Cambridge must be fully stamped or they will be liable to miscarry. It is hoped that particular attention will be paid to this point, as otherwise much inconvenience may arise from delay or loss of letters and samples.

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West Surrey Goat Club.

WITH the object of giving the public a general idea of the possibilities of goat keeping as an industry and as a profitable branch of small holding work, the West Surrey Goat Club held their third annual show at Stoke Park, Guildford, at the end of May. There were no fewer than 23 classes, with an average of about eight goats in each class, while 28 different breeders entered exhibits. Most of the breeds in this country were represented, among them being the British Alpine, British Saanen, Anglo-Nubian, Swiss. Toggenburg and British Toggenburg. M. T. W. Palmer, Secretary of the British Goat Society, was the judge. The goats were of remarkably good quality and included many excellent milkers, one of which had given on the day of the show over 8 lb. of milk. Miss McLeod, County Dairy Demonstrator, lectured on butter and cheese making from goats' milk and gave working demonstrations. Model goat houses and dairy and stable appliances were also on view.

One of the features of the show was Mrs. Lacy-Hulbert's exhibition of fur-bearing rabbits, as well as cured skins of kids,

goats and rabbits, and a wide variety of articles made therefrom, ranging from gloves to white beveren coats for children. It would appear that, if properly handled, there should be a profit in the production of good rabbit pelts.

The West Surrey Goat Club have also arranged goat classes at various agricultural shows taking place during the season in the district. Among other goat shows held this season was that of the Sussex County Goat Club, which took place in May in conjunction with the Sussex County Agricultural Society's Show.

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A Successful Egg-Collecting Society.

A brief account of the Fairford and Cirencester Egg Depôt, Limited, a successful Society for the collection and sale of eggs, may be of interest to those engaged in the poultry industry. There is considerable scope for the development of the idea that poultry-keepers working in co-operation can supply markets in a way which is much more profitable to the individual than if he tried to do his business alone.

The advantages which this enterprising Society lays before its members may be summed up as follows:—(1) An efficient motor-collecting service; (2) No expense of marketing; (3) Large or small quantities of eggs accepted; (4) Payment for eggs, at the best possible price obtainable, made in cash either monthly or quarterly; (5) Profits distributed amongst members; (6) Free advice on ailments of poultry.

The Society was established in 1901 and since 1904 has made profits every year and increased its egg sale until it now reaches over a million annually. The Society has contracts to supply eggs to several large hospitals and also to His Majesty the King.

It is no part of the Society's aim to make large profits. These are kept as low as possible, the aim being to get as high a price for the members' eggs as can be got. This price is decided each week by the manageress after careful scrutiny of the markets and the relevant information. As the price is fixed for the whole week, great care and circumspection are necessary, and, if good judgment is not used, large sums can easily be lost. A great point with the Society is never to refuse to take eggs from its members, even in times of glut. When these occur, and the Society has more eggs than it has a clear demand for, it does not preserve any eggs, its policy being against that course on the view that preservation does not really pay owing to foreign competition. At such times, the Society finds that its regular

customers will help it out by taking as many eggs as possible, and to such customers the Society reciprocates by supplying them first with eggs during a shortage.

The Society pays carriage on all eggs dispatched, though this gives them the trouble of making any necessary claims to the railway companies for loss or damage. It finds, too, that it is safer and cheaper to send eggs by goods' train at owner's risk. When this is done, the railway companies more readily listen to claims for theft or damage than when the eggs are consigned by passenger train.

Recently, the Society has been much concerned on account of the excessive number of undersized and dirty eggs received and has issued a notice to its members calling their attention to this fact, and informing them that in future 3d. per dozen less than the price quoted as the price for the week will be paid for dirty eggs and for eggs under $1\frac{3}{4}$ oz. weight. The notice points out that foreign eggs of large size and excellent quality are coming into the country, and that the Society can only maintain its place in the market if its members keep the best stock and manage their poultry in the most approved fashion. The Society is ready to give its members free expert advice on any question concerning stock, particularly in those cases where deterioration of stock and eggs has occurred. The example of this pioneer Society might well be followed in other rural communities.

AGRICULTURE ABROAD.

Milk Recording in Canada.

It is fully recognised by many Canadian farmers that the milking herds of the country can be much improved by means of milk records. The information obtained from the records is applied in two ways: (1) to the elimination of the poorer animals from the herds, and (2) to the selection of pure-bred dairy bulls possessing inherited dairy qualities of a high order for use in the herds.

Mr. A. H. White, the senior dairy promoter attached to the Dominion Department of Agriculture at Ottawa, reports that a brief analysis of the records of most of the Ontario herds shows that even in the better of them there are nearly always one or two poor cows, and that where there is no systematic effort to grade-up the herd, it is not uncommon to find one-quarter of the animals not even paying for their feed. In one instance of 540 cows recorded, the average production for 1920 was 7,094 lb. of milk and 248.8 lb. of fat, against an estimated average production in Ontario of about 4,000 lb. of milk. The best record was of a cow which produced 14,160 lb. of milk and 545.6 lb. of fat, and the poorest yield was 1,595 lb. of milk and 79.9 lb. of fat. This is an astonishing difference. Further analysing these records, Mr. White points out that the best 135 cows produced more than twice the amount of milk and fat than the poorest 135 cows, though the latter yield was about equal to the estimated average production of all the dairy cows in Ontario. These figures make it clear what latitude there is for improvement. It should be remembered that all increased production is practically net profit, because a poor cow requires the same amount of food and attention as a first-class one. The total number of cows recorded in Canada in 1920 was 33,382 in 3 847 herds at 564 centres. This shows an increase of nearly 50 per cent. on the number tested in the previous year, so that the practice of milk-recording is growing very rapidly in Canada. It appeals to the Canadian dairy farmer as a certain money maker, and it is safe to predict that none will give it up. Its immediate success is attributed very largely to the enthusiasm of the Canadian Government dairy instructors. In addition to this work, instructors supply milk record forms to farmers who are too far from an organised centre to have samples of milk tested regularly for butter fat. Thus these farmers may keep their own figures.

A case is cited in a recent issue of *The Agricultural Gazette of*

Canada of an Ontario dairyman who started 12 years ago with a common herd of cows each producing only about 5,000 lb. of milk per annum. By careful selection and a ruthless weeding-out of poor cows, he possessed last year a herd whose produce averaged more than double that weight of first-class milk. Three of his cows each produced more than 18,000 lb. of milk and 460 lb. of fat.

It is impossible to emphasise too strongly the importance of milk records in the selection of the best strains of milking cows for the production of the best dairy sires. Many a bull calf looks very promising, but it is impossible to judge its value as a potential factor in a milk herd without figures of the milking properties on both sides of its ancestry.

Improving the Native Fowl in Northern Nigeria.

PARTICULARS of a successful experiment, which has been in progress since 1919, to improve the native fowl in Northern Nigeria by crossing them with pure breeds imported from England, are supplied by Mr. P. H. Lamb, Director of Agriculture for the Northern Provinces of that country. Through Mr. P. Hedworth Foulkes. Principal of Harper Adams Agricultural College, Newport, Salop, two cockerels and six pullets of each of the following breeds were obtained:—Indian Game, Light Sussex and Rhode Island Reds. The cockerels were not related to the pullets or to one another, for the future introduction of fresh, pure blood would be difficult. Two of the Light Sussex died on the voyage; the remainder were placed on arrival at Kaduna in specially prepared pens affording protection from the mongoose and wild cat. The site was elevated, well drained, and previously free from poultry.

The native fowl is described as having the appearance of an ill-conditioned bantam, and its utility qualities either as a table fowl or as a producer of eggs are very poor. The country experiences great extremes of temperature. During the hot (which is also the wet) season from April to September the thermometer rises to 104° F. in the shade; while during the cold dry season, from October to March, it drops to 45° F. There is almost continuous rain for six months, and the country is parched and produces no natural green food for the remaining six months. The staple food of the country is Dari (*Sorghum vulgare*) known as guinea corn. It is also the corn commonly fed to the poultry, and in the case of the imported fowls it was dug into the litter

first thing in the morning, followed at 4 p.m. by a soft feed of boiled sweet potato (yam) mixed with green bone. In the dry season, when there is no natural green food, chopped lettuce grown specially in gardens which are watered daily was fed to the birds. From January to March mussels obtained from the shrunken river beds were given, the pounded shells being fed as shell grit all the year round. Some maize was fed to growing stock, but wheat and other European grains are scarce.

With the exception of a short period at the beginning of the dry season in October, hens lay eggs all the year round in Northern Nigeria. Moulting takes place between August and November. As there is no skilled labour on the Kaduna breeding station, only natural hatching is resorted to, and this goes on throughout the year, the best results being in March. The percentage of eggs hatched varies from 60 to 90. Newly-hatched chicks are fed on broken wheat, broken dari and millets, and the larvæ of termites (white ants), boiled rice being added a few days later. Charcoal is fed to birds of all ages, and chickens have it powdered in their soft food (yams). Glauber salts and iron sulphate are put in the drinking water for 24 hours each week, and sulphur is mixed in the soft food in very hot weather. The problem of insect pests is a serious one, lice, red mite, and poultry tick being common among the native poultry, the last named being much dreaded as a disease carrier. As a preventive, all the birds on the station are dipped once a quarter in a 5 per cent. paraffin emulsion, while any houses badly infested are burned. This treatment has proved very successful. The only disease from which the imported poultry have suffered so far is chicken pox, which is enzootic among the native fowl and was probably introduced with the bran bought at a local market; no native fowls are kept within a quarter of a mile of the breeding station. This disease ran through the whole yard, but yielded readily to antiseptic treatment, there being no mortality.

No egg records are available, as the number of birds has varied and all the hens have been used regularly for sitting. It is hoped to raise on the breeding station a large number of pure bred fowls, and in the first place to distribute the cockerels (by sale) to the chiefs of the villages in order to improve the native fowl by crossing. The first crosses with the native fowl are half-caste in appearance and intermediate in size between the imported and native breeds. Over 100 of the pure-bred cockerels reared at the station have already been distributed over an area extending from Sokoto to Lake Chad.

NOTICES OF BOOKS.

The Nutritive Value of Lard.—(J. C. Drummond, J. Golding, S. S. Zilva and Katharine H. Coward: The *BIOCHEMICAL JOURNAL.* Vol. XIV, No. 6, December, 1920. Cambridge University Press.) During the last few years considerable attention has been devoted to the study of the distribution of the so-called fat-soluble accessory factor, or vitamin A, in naturally occurring oils and fats. Investigations tend to show that the oils and fats derived from the animal kingdom are, as a rule, decidedly richer sources of this essential dietary constituent than those prepared from vegetable sources. Most authorities, however, regarded lard as an exception, having found it practically devoid of vitamin A. Quite early in the study of growth-promoting vitamins it was observed that butter fat was of much higher nutritive value for growth than lard. This difference has been ascribed to the fact that lard is a fat derived from storage depots, whereas butter fat is a product of the synthetic processes of the mammary gland. The importance of determining definitely why lard is thus deficient is, therefore, obvious. The first series of experiments by the group of workers named above were carried out on a litter of Berkshire pigs at the farm attached to University College, Reading, while the rat feeding tests took place at University College, London, and the results were published in the *Biochemical Journal* in December last.

It is now experimentally proved that the mammalian organism does not possess the power to synthesise the vitamin A, and that it is dependent upon its diet for supplies of this essential factor. Hence it was concluded that investigations should proceed along two lines, (1) a study of the influence of the diet of pigs on storage of the vitamin in the fat depots, and (2) an investigation of the influence of the technical processes of lard manufacture on the vitamin when present in the pig fat.

The results of the experiments are summarised as follows :—

(1) The pig is able to store up supplies of vitamin A in the body fat when fed upon a diet containing ample supplies of that factor, as for example when grass fed.

(2) When the diet of the pig is deficient in vitamin A, as for example when it consists almost entirely of toppings and whey, no appreciable amounts of that dietary factor can be detected in the body fat.

(3) The processes employed in the manufacture of lard on a large scale in this country cause a very marked destruction of the vitamin present in the pig fat.

(4) The low nutritive value of lard is therefore believed to be due to two causes. First, the diet usually given to fattening pigs in this country is seldom rich in vitamin A, so that the average sample of pig fat contains little or none of that substance. Secondly, the processes of lard manufacture undoubtedly cause the destruction of much of the vitamin present in the original pig fat, probably owing to the exposure of the fat to oxygen at high temperature.

Poultry Keeping.—(C. A. Flatt. London: Methuen & Co. Price 5s. 6d.) Poultry farming is a highly specialised business, and, as such, requires considerable practical experience if it is to be made a success.

Mr. Flatt makes this important fact amply clear in a straightforward way, and in the simplest possible language; his book should, therefore, be of particular value to the beginner. More importance is attached to practice than to theory, and rightly so. Many people still think that they have only to put any kind of hen into any kind of hovel, when she will of course lay large numbers of eggs. Unfortunately for that theory, the hen is a creature of nature, and must be treated accordingly and not as a machine. The amount of detail which the poultry keeper is called upon to superintend is so considerable that no one need imagine that he is likely to make a success of the business with less than a year's practical training. Moreover, it is such a useful adjunct to almost every other form of agriculture, fruit growing and horticulture in particular, that it behoves those interested in such forms of husbandry to consider whether this branch of agriculture could not be advantageously combined with their other operations, (1) because of the assistance poultry afford in keeping down pests, and (2) because of the great value of poultry manure when properly applied, quite apart from (3) the profits that would accrue from the poultry themselves when properly cared for. These important considerations are emphasised throughout Mr. Flatt's book.

Poultry keeping does not involve hard labour, but it does necessitate unremitting attention to detail, and often long hours, particularly when the successful rearing of chickens is the object in view. Chicken rearing, by the way, is quite the most absorbing branch of poultry keeping, and can be conducted with great advantage as an adjunct to dairying, since skim and sour milk are of especial value to growing stock.

The reader will find the chapter on poultry foods of great interest, as it deals with a highly technical subject in a lucid way. Ducks, turkeys and geese are appropriately dealt with, and in relation to the commoner poultry diseases it is shown that prevention is far better than cure.

The results of Mr. Flatt's wide experience as a poultry-keeper and as Poultry Instructor to the Devon County Council and other bodies are offered to the public in a concise and simple form.

Agricultural Returns, England and Wales, 1921.

The preliminary tabulation of the Agricultural Returns collected on the 4th June, 1921, in respect of agricultural holdings of over one acre in England and Wales shows that the total area under all crops and grass is 26,139,000 acres, a decrease since last year of 368,000 acres. On the other hand, the area of rough grazings (which comprises mountain, heath, moor, down and other rough land used for grazing) is now 4,555,000 acres, or 393,000 acres more than at the same date in 1920.

Cereals.—The area of wheat, 1,978,000 acres, is 103,000 acres more than in 1920, and, excluding the war years, is the largest recorded since 1898. Barley and oats, on the other hand, have declined, the former by 202,000 acres and the latter by 127,000 acres. The area under barley, 1,435,000 acres, is less than the pre-war level, but that of oats, 2,145,000 acres, is higher than in any pre-war year since 1908. The total area under the three cereal crops (including mixed corn) is 5,694,000 acres, or 400,000 acres more than the average of the ten years 1905—1914.

Beans and Peas.—The area of beans is 246,600 acres, or 10,500 acres less than in 1920, while peas show a much greater decline, and this year's area of 142,400 acres is smaller than in any year before the war.

Potatoes.—The area occupied by potatoes has again increased, and at 557,000 acres is the largest recorded, with the exception of that of 1918.

Roots.—A decline of 97,100 acres on last year is shown in the area of turnips and swedes, and this year's area of 894,000 acres is the smallest on record. It should be mentioned that, at the date of the returns, much of the

PRELIMINARY STATEMENT of Acreage under Crops and Grass and Numbers of Live Stock in England and Wales on 4th June, 1921.

DISTRIBUTION.	1921.	1920.	INCREASE		DECREASE.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL ACREAGE under all CROPS and GRASS	26.139,000	26,507,000	—	—	368,000	1·4
*ROUGH GRAZINGS	4 555.000	4,162,000	393,000	9·4	—	—
ARABLE LAND	11.618 000	12,020,000	—	—	40[illegible],000	3·3
PERMANENT GRASS { For Hay ..	4.054 000	4 395,000	—	—	341,000	7·8
PERMANENT GRASS { Not for Hay ..	10 467 000	10,092,000	375,000	3·7	—	—
PERMANENT GRASS { TOTAL .	14 521.000	14,487,000	34,000	0·2	—	—
Wheat { Autumn Sown	1 911.000	1,793,000	118,000	6·6	—	—
Wheat { Spring Sown	67,000	82,000	—	—	15,000	18·3
Wheat { TOTAL	1.978 000	1,875,000	103,000	5·5	—	
Barley	1 435.000	1,637,000	—	—	20[illegible],000	12·3
Oats	2.145 000	2,272,000	—		127,000	5·6
Mixed Corn	136.400	147,500	—	—	11,100	7·5
Rye	79,400	95,600	—	—	16,200	16·9
Beans	246 600	257,100	—	—	10.500	4·1
Peas	142 400	165.700	—	—	23,300	14·1
Potatoes	557.400	544,600	12,800	2·4	—	—
Turnips and Swedes	894 300	991,400	—	—	97,100	9 8
Mangold	374.800	385,900	—	—	11,100	2·9
Cabbage, Savoys and Kale .. .	58 000	62,100	-	—	4,100	6·6
Kohl-rabi	9.900	11,000	—	—	1,100	10·0
Rape	81 900	100,300	—	—	18,400	18·3
Vetches or Tares	103 700	121,700	—	—	18,000	14·8
Lucerne	47.400	44,500	2,900	6·5	—	—
Mustard	45 200	71,900	—	—	26,700	37·1
Brussels Sprouts	12.500	12.600	—	—	100	0·8
Cauliflower or Broccoli	8 600	8,800	—	—	200	2·3
Carrots	8 200	9,600	—	—	1,400	24·6
Onions	2.900	4,500	—	—	1,600	35·6
Sugar Beet	8.300	3,000	5,300	176·7	—	—
Flax for Fibre	1,700	9,400	—	—	7,700	81·9
Linseed	6 100	12.900	—	—	6,800	52·7
Hops	25 100	21,000	4,100	19·5	—	—
Small Fruit	73.300	58,800	14.500	24·7	—	-
CLOVER and ROTATION GRASSES { For Hay ..	1,757.000	1,674.000	83,000	5·0	—	—
CLOVER and ROTATION GRASSES { Not for Hay	791.000	774,000	17,000	2·2	—	—
CLOVER and ROTATION GRASSES { TOTAL ..	2 548.000	2,448,000	100,000	4·1	—	—
BARE FALLOW	506.000	567,000	—	—	61,000	10·8

* Mountain, Heath, Moor, Down and other rough land used for grazing.

land intended for turnips had not actually been sown, and the character of the season has been such that a proportion of this land may now be devoted to other crops for fodder, such as vetches. There has also been a small decline in the area of mangold, which at 375,000 acres is the smallest for 20 years.

Other Crops.—Most of the other crops have declined in area, the most noticeable decreases occurring in the case of mustard, flax for fibre, linseed and onions. The decline in the fodder crops—cabbage, kohl-rabi, rape and vetches—is on the whole less than the general increase noted last year. The area of sugar-beet is nearly three times that of last year, whilst hops again

show a substantial increase. According to the returns the area under small fruit has increased by 14,500 acres, or nearly 25 per cent., the total area being 73,300 acres, which is about the same as in 1916.

Clover and Rotation Grasses.—The area of clover and rotation grasses has increased by 100,000 acres to 2,548,000 acres, of which 1,757,000 acres were reserved for hay. Including permanent grass, the total area reserved for hay this year was 5,811,000 acres, as compared with 6,069,000 acres in 1920.

Horses used for agricultural purposes (including mares kept for breeding) have increased by 33,600. Other classes show slight reductions, and the net increase in horses on agricultural holdings is 18,700.

LIVE STOCK.

	No.	No.	No.	Per Cent.	No.	Per Cent.
Horses used for Agricultural purposes (including Mares for Breeding)	822.500	788,900	33,600	4·3	—	—
Unbroken Horses (including Stallions) One year and above	233.200	235,500	—	—	2,300	1·0
Unbroken Horses (including Stallions) Under one year .	92.300	97,300	—	—	5.000	5·1
Other Horses	236.400	244,000	—	—	7,600	3·1
TOTAL OF HORSES . ..	1.384.400	1,365,700	18,700	1·4	—	—
Cows and Heifers in Milk . .	1 875 900	1,827,700	48.200	2·6	—	—
Cows in Calf, but not in Milk	251.800	243,000	8,800	3·6	—	—
Heifers in Calf	373.600	282,100	91,500	32·4	—	—
Other Cattle:—Two years and above ..	1.001.300	1,177,900	—	—	176,600	15·0
,, ,, One year and under two	893.400	1.109,000	—	—	215,600	19·4
,, ,, Under one year.. .	1.119.600	907,100	212,500	23·4	—	—
TOTAL OF CATTLE . ..	5.515.600	5,546,800	—	—	31,200	0·6
Ewes kept for Breeding . ..	5,308.300	5,108,500	199,800	3·9	—	—
Other Sheep:—One year and above ..	2.861.900	3,004,800	—	—	142,900	4·8
,, ,, Under one year	5.636.000	5,269,400	366,600	7 0	—	—
TOTAL OF SHEEP	13 806.200	13,382,700	423,500	3·2	—	—
Sows kept for Breeding	335.800	289,500	46,300	16 0	—	—
Other Pigs..	2 169.900	1,704,400	465,500	27·3	—	—
TOTAL OF PIGS	2 505.700	1,993,900	511,800	25·7	—	—

Cattle.—Although the total number of cattle shows a small decline on last year of 31,200 head, the figures are nevertheless satisfactory in that the only decreases recorded are confined to cattle one year old and over (other than breeding animals), and are largely consequential on the heavy decline in the number of animals under two years noted last year. The increase in calves is satisfactory, and, taken in conjunction with the increase in breeding animals, suggests that the number of cattle in the country will shortly rise to pre-war figures. The total number of cows and heifers, in milk or in calf, is 2,501,300, or 148,500 more than last year, and is larger than in any previous year with the exception of 1918 and 1919.

Sheep.—The number of sheep, which has been declining heavily in recent years, has now increased by 423,500 to 13,806,000—a noticeable feature being the increase of 200,000 in the case of ewes kept for breeding.

Pigs have increased by the large figure of 511,800 (over 25 per cent.) to 2,505,700, the largest total recorded since 1911. The increase of 46,300 in the number of sows kept for breeding, although proportionately less than in the case of other kinds, is especially satisfactory.

ACREAGE OF HOPS IN ENGLAND & WALES, 1921.—The following is a preliminary statement compiled from the Returns collected on the 4th June, 1921, showing the ACREAGE under **Hops** in each COUNTY of ENGLAND in which Hops were grown, with a COMPARATIVE STATEMENT for the Years 1920 and 1919.

COUNTIES, &c.		1921.	1920.	1919.
		Acres.	*Acres.*	*Acres.*
KENT	East	4,000	3,260	2,530
	Mid	5,420	4,520	3,650
	Weald ...	6,640	5,710	4,380
	Total, Kent ...	16,060	13,490	10,560
HANTS		1,040	840	760
HEREFORD		3,510	2,990	2,420
SURREY...		200	170	180
SUSSEX		2,270	1,790	1,410
WORCESTER		1,960	1,660	1,370
OTHER COUNTIES		80	60	50
TOTAL		25,120	21,000	16,750

Plans for Poultry Houses.

The Ministry's set of small model poultry houses which have been exhibited at certain shows have proved of considerable interest to many visitors, and inquiries have been received for working drawings of houses capable of erection at a minimum expense of money, time and labour. Plans have accordingly been prepared as follows :—

1. *Drawings of a Fowl-House for 6–9 Birds.*—These are sketches of the framing of a house suitable for back-yard poultry-keepers, for birds kept on the intensive system.

2. *Drawings of a Duck-House 16 ft. by 10 ft.*—These are suitable for "utility" duck-keeping.

3. *Drawings of a Hen-House 8 ft. 6 in. by 6 ft. 8 in. by 7 ft. 6 in. high.*—These are suitable for use on free range or farm. The house can be made portable if desired.

4. *Drawings of a House for 25 Birds or Double Breeding Pen.*—The house can be used for either purpose without structural alteration.

5. *Drawings of an 11 ft. Laying House.*—This house has been designed in sections, each capable of holding 25 birds, and can be enlarged by the addition of extra sections. There is perch room in each section for 27 birds, thus preventing over-crowding on perches.

(4) and (5). These houses have been designed to obtain the maximum amount of ventilation and light, together with economy of space, consistent with proper perch accommodation. Special care has been taken to keep the size of timber used in the construction as small as possible and easy of erection.

The plans may be obtained from H.M. Stationery Office, or direct from the Ministry's Office, 10, Whitehall Place, London, S.W.1., price 3d. per copy.

Export of Live Stock to Argentina.—The Argentine Government, in a Decree issued on the 14th July, authorised the importation of live stock into Argentina from the United Kingdom, and made it a condition that the stock must be carried on ships which make a direct voyage from British to Argentine ports. This condition has in practice been found to create certain difficulties in connection with the export of stock from the United Kingdom to Argentina, since most vessels from British to Argentine ports call *en route* at Monte Video, Uruguay.

As a result of representations by the Ministry of Agriculture and Fisheries, the Argentine Government issued a further Decree excepting the port of Monte Video from the condition mentioned.

Leaflets issued by the Ministry.—Since the date of the list given on page 478 of the August issue of this *Journal*, one new leaflet has been issued and circulated :—

No. 364.—Coccidiosis in Rabbits and Poultry.

The following leaflets have been revised and brought up to date :—

No. 46.—The Stem Eelworm.
,, 70.—The Renovation of Neglected Orchards.
,, 129.—Winter Egg Production.
,, 320.—The Manuring of Vegetable Crops.

The following leaflet has been re-written :—

No. 283.—Storing of Apples and Pears for Home use.

The following leaflets have been withdrawn from circulation.

No. 149.—Threshing of Barley.
,, 247.—Shot-hole Fungus.
,, 323.—The Profitable Utilisation of Surplus Milk.
,, 359.—Bracken as litter.

Rabies.—There has been no outbreak of Rabies in any part of Great Britain since that referred to in the August issue of the *Journal*, viz., at Southampton on 5th July in a dog which died on 4th June. As from 8th August, all restrictions were withdrawn from the small area lying to the south of Swindon.

Foot-and-Mouth Disease.—An outbreak of Foot-and-Mouth Disease occurred at Dilhorne, near Stoke-on-Trent, on the 10th August, after a period of over two months freedom from disease.

The usual restrictions were at once imposed in respect of the district lying within 15 miles of the infected premises, and except that on the 11th August, animals on the immediately adjoining farm were found to be affected, there had been no extension of disease up to the time of going to press. The slaughter of all the animals involved has been completed.

Revocation of the Testing of Seeds Order.—In exercise of the powers conferred upon them, the Board of Trade have revoked as on 1st August, 1921, the Testing of Seeds Order, 1918, as amended, but without prejudice to any proceedings in respect of any contravention thereof.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 7.

OCTOBER, 1921.

NOTES FOR THE MONTH.

Conciliation Committees in Agriculture.

STEADY progress is being made by the Interim Conciliation Committees, which are being set up in England and Wales under the Corn Production Acts (Repeal) Act. With one or two exceptions the Committees have adopted their constitution, have decided whether or not to appoint an independent Chairman, and have considered those questions of procedure which must necessarily arise in the early stages of working.

The question of dividing the existing District Wages Committee areas into smaller areas and into sub-divisions has in some cases led to lengthy discussions, and many Committees have decided to dispose finally of this question before considering the question of wages and hours. In Yorkshire, three Committees have been agreed on; one for each of the Ridings. Separate Committees have been formed for Cambridgeshire and also for the Isle of Ely, but Huntingdonshire and Bedfordshire will continue as one Committee, at least for the time being. The Middlesex and Hertfordshire organisations have agreed that these counties shall no longer form a single area. Similarly, a separate Committee has been decided on for Rutlandshire, while for Leicestershire, which previously with Rutlandshire formed one area, a division into four areas has been agreed. A suggestion has also been made for a separate Committee for the Market Harborough area of Northamptonshire.

A constitution having been adopted, and the area question either disposed of or postponed for later consideration, many Committees have already been able to consider seriously what rates of wages should be recommended after the 1st October. Up to the 24th September, agreements as to wages after the 1st October had been recorded in four areas. The Cheshire and Surrey Committees have agreed that wages should continue payable at the rates left by the Wages Board until the 31st October, and the Denbigh and Flint Committee has

similarly agreed that the present rates should continue until the 5th November. The Staffordshire Committee has, however, decided on a new system by which wages are to be paid in future on an hourly basis, the agreement arrived at by the Committee being that for the period from the 1st October, 1921, to the 29th January, 1922, the minimum wage for adult able-bodied male workers should be at the rate of 9½d. per hour, and that a minimum of 50 hours per week be worked, leaving employers and workers to make mutual arrangements with regard to any further hours; Sunday work to be paid at the rate of 1s. per hour.

* * * * * *

An Agricultural Index Number.

THE interest which has been aroused by the use made of the "Cost of Living" Index Number in recent discussions on wages has familiarised the public with the idea of an Index Number which expresses in a single figure the variations in the prices of a number of commodities. A figure of this kind which is of considerable interest to agriculturists has for some years past been prepared annually by the Ministry of Agriculture, and more recently this annual figure has been supplemented by a Monthly Number which aims at recording from month to month the changes in the prices of the principal articles which the farmer sells. These index numbers are based on the wholesale prices recorded week by week of agricultural produce, the average prices in the years 1911-13 being taken as a basis of comparison. The method of calculation remains the same throughout and therefore enables a fair comparison to be made of one year with another, but it is important to remember that the number merely represents the *average* increase or decrease which has taken place in a number of very different commodities, allowance being made as far as possible for the varying importance of the articles sold. Thus, as the sale of cattle is, on the whole, a more important item in the farmers' budget than the sale of wheat, greater allowance is made for changes in the former item than in the latter. The importance given to the different articles does not, however, vary from year to year, as that would destroy the value of the index number for purposes of comparison, and in practice the change which would be introduced by an attempt to adjust the weights to the total quantities produced has been found to be insignificant.

Taking the average prices during the basic years 1911-13 as 100, the average increase per cent. in each of the subsequent years has been found to be as follows:—

	Incr. per cent.		Incr. per cent.
1914	1	1918	132
1915	27	1919	158
1916	60	1920	192
1917	101		

These figures represent the average of the calendar years. It will be seen that, whilst in the first two years of the war the increase in agricultural prices was small, by 1917 prices had practically doubled; while in 1920, on the average they were 192 per cent. above those ruling in 1911-13. Although this was the average figure for the whole year, considerable reductions took place in certain articles during 1920, and these reductions, as is well known, have been continued and emphasised in 1921. To form an idea of current changes, it is necessary to have recourse to a monthly index number.

The monthly index number is more liable to error than the annual figure, owing to the fact that there are fluctuations in the quantities marketed from month to month, and seasonal variations in prices, which render the system of weights less satisfactory. By excluding certain commodities, such as hops, wool, fruit and vegetables, which are particularly subject to these variations, an approximate monthly index number is obtained which gives in broad outline the changes from month to month. Since the beginning of 1919 the figures have been as follows :—

Month.	Increase per cent. on the average of the years 1911-13.		
	1919.	1920.	1921.
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	—
October	166	191	—
November	182	197	—
December	207	194	—

During 1921, it will be seen that agricultural prices fell steadily from January to July. In January they were still on the average 186 per cent. above the 1911-13 level, in July they were only 100 per cent. higher—that is, approximately double the figures ruling during the three years before the War.

In August prices showed some recovery, due in part to the seasonal increase in milk prices which normally occurs in August

as compared with July, but more especially to the fact that an additional 3d. per gallon beyond the normal increase was paid more or less generally throughout August on account of the increased cost of milk production owing to the drought. Fat stock also showed a slight increase in value, but cereals, with the exception of barley, were cheaper during August than July.

Fourth Meeting of the Council of Agriculture for England.

THE Council met on 17th August, 1921, at 11 a.m. in the Middlesex Guildhall, Westminster, S.W.1. the Earl of Selborne, K.G., G.C.M.G., being in the Chair.

The proposed alteration of national agricultural policy as contemplated in the Corn Production Acts (Repeal) Bill was discussed, and in the course of the discussion Lord Bledisloe gave notice of a motion for the next meeting of the Council in the following terms:—

"That this Council desires respectfully to represent to His Majesty's Government that constant, sudden and far-reaching changes in national agricultural policy are calculated both to restrict the production of the nation's food, and to cause irretrievable injury to British Agriculture and to all classes of the agricultural community."

Sir Douglas Newton gave notice of a resolution in the following terms:—

"That in view of the sudden and drastic alteration made by the Government in their agricultural policy, they are hereby respectfully requested to make provision for advances on loan, in approved cases, of working capital to farmers who have recently purchased their holdings, on somewhat similar lines to those followed in the case of small holders."

The Minister addressed the Council on the general question. At a later stage in the discussion, Mr. C. P. Hall moved that "This Council do now adjourn until this day month," and he gave notice that he would then move that "The Council do consider whether it has any further opportunities of useful service in view of the recent attitude to it of the Ministry of Agriculture." Mr. Hall's motion was seconded by Mr. J. V. Wheeler. The Chairman called attention to the fact that a motion that the debate, or Council, do now adjourn should be seconded without a speech, and put by him without debate. He suggested that the form of the resolution should be altered as follows: "That this debate be now adjourned until an early date, when Mr. Hall

will move that the Council do consider whether it has any further opportunities of useful service, in view of the recent attitude to it of the Ministry of Agriculture." On a point of Order, Lord Bledisloe suggested that it might be possible under Standing Order 4 for a resolution to go forward from the Council as one of urgency, without waiting for another meeting. The Chairman replied that he would take the feeling of the Council as to whether the Standing Orders should be suspended under Standing Order 29, in which case three-fourths of those present and voting would have to vote in favour of the matter being one of urgency in order to carry the motion; he would not declare it to be one of urgency under Standing Order 4. The issue was put to the vote and the Chairman announced that the required proportion of votes was not reached. Mr. Hall's motion was then put and carried, and the debate accordingly adjourned.

Mr. W. Osborn moved :—

"That it is the duty of this Council to invite representatives of the Landlords, the Tenant Farmers, and the Agricultural Labourers to join in an attempt to frame an agreed agricultural policy."

Mr. Nunneley seconded the motion, which, after discussion, was, by leave, withdrawn.

The Report of the Proceedings of the Agricultural Advisory Committee for England and Wales, dated August, 1921, was received by the Council.

* * * * * *

Late Claims Under the Corn Production Acts.

A NUMBER of farmers have failed to send their claims to the Ministry of Agriculture for payments in respect of wheat and oats of the 1921 crop provided for by the recent Act of Parliament, or have sent them in later than 18th July, the last day fixed by Regulation. In order to avoid hardship in individual cases it has been decided to extend the date to 3rd October next.

The Ministry cannot undertake to make payments in respect of these late claims by 1st January next, but payment will be made as soon after as possible.

A claim form with an explanatory note has already been sent direct from the Ministry to all those persons who have filled in an Agricultural Schedule, but have not made a claim, and an acknowledgment has been sent to all those persons who had already made claims subsequent to 18th July.

Weekly Return of Market Prices.

SINCE 1904, the Ministry has published a Weekly Return of Market Prices summarising the trade in the various classes of agricultural produce and requisites at leading markets throughout the country. The Return includes a summary of the trade movements generally, with more detailed reports regarding certain selected markets, which are together representative of the trade of the country as a whole. Tables are included, showing in convenient form the average prices of the various commodities at each market week by week. The Return has hitherto been supplied to the public free, but, in view of the increased cost of printing and publishing, the Ministry has decided that after the end of this year it can be issued only to subscribers. The rate of subscription will be announced later. Farmers who do not already receive the Return may obtain a specimen copy on application to the Ministry.

* * * * * *

Imperial Fruit Show.

AN article in the issue of this *Journal* for September, p. 540, gave an account of the Imperial Fruit Show to be held at the Crystal Palace from 28th October to 5th November. Schedules relating to the Commercial Section, the Amateur Section, the Cider Section, and the Overseas Section, have now been issued, and fruit growers throughout this country, and the other parts of the Empire where apples are grown are now busy selecting from the general bulk the show fruit for competition in the various classes.

Present information indicates that nearly 40,000 cases of apples will be exhibited at the Crystal Palace, and of these some 5,000 or 6,000 are expected from Canada. Such a display of apples should have the effect of attracting to the Crystal Palace the general consuming public of London and adjoining centres.

The growers, and indeed the whole of the horticultural industry, now realise that a show of this importance provides a unique opportunity for further propaganda to interest the public in the use of apples, and so lead to a greater consumption, thus encouraging the industry to increase its acreage without the risk of the supply being in excess of the demand.

The Federation of British Growers have in hand a project whereby samples of named varieties of apples will be supplied to the public, in order that they may become acquainted with the merits of the different varieties. The National Farmers'

Union hope to put up an attractive stand dealing especially with the apple crop, while members of the Union are co-operating to exhibit apples in the British Empire Class in the hope that the home-grown fruit may secure a premier place over the imported. The National Association of Retailers are providing prizes for an attractive Window Dressing Competition open to retailers throughout the United Kingdom. Show windows are to be dressed with apples during the week of the Imperial Fruit Show, and the prizes will be awarded by judging photographs of the windows. Such a competition should be very attractive to the retail trade, and of considerable importance in attracting the public to the show, and in increasing their interest in the apple.

It is understood that through the Wholesale Section of the trade arrangements have been made with a school of cookery for giving demonstrations in methods of cooking apples. The National Association of Cider Makers, in conjunction with the Cider Institute of Bristol, are installing plant and machinery, and demonstrations in cider making will be given every day throughout the show. The Ministry is arranging conferences, at which lectures will be given dealing with the various phases of fruit growing, and the value of the apple as an article of diet. Some lectures will be scientific, and some will be popular and of interest to the general public.

The question of grading and packing, which has lately come so largely before British growers and the general public, will be strongly represented, and the Ministry has arranged for continuous demonstrations. It is probable that three of the most expert packers from Canada will be available to assist the Ministry on this occasion.

A show conducted on these lines should guide growers to adopt the more approved methods of marketing; help those engaged in the horticultural industry by providing information as to the requirements of the growers; and increase the consumption of apples by the public.

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Egg and Day-old Chick Distribution Scheme, 1921.

PRELIMINARY figures of the distribution of sittings of eggs and day-old chicks under the Ministry's scheme during the 1921 season are now available. The object of the scheme is to provide small-holders, cottagers and others with stock of good quality at reasonable prices, and thus improve the utility value of the poultry stock kept by small occupiers throughout the country. The number of

eggs (to the nearest thousand) distributed in 1921 was over 104,000, being a slight decrease on the figures for 1920 (118,000) but an increase of nearly 100 per cent. over those for 1919 (53,000). The number of day-old chicks distributed was nearly 38,000, an increase of nearly 17,000 over the previous year and 35,000 above the figures for 1919. The total number of stations engaged in the work of distribution is now 256, showing an increase of 84 since last year and 93 more than in 1919. In 1921 the number of ducks' eggs distributed was nearly 1,500, as compared with less than 100 in 1920, when the distribution of ducks' eggs was included in the scheme. A beginning was made this year in distributing ducklings, over 200 being distributed by 28 stations. The scheme is administered by local authorities, and in view of the necessity for economy and the fluctuating prices during the season, the distribution during 1921 is regarded as quite satisfactory.

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The Epizootic Abortion Order, 1921.

THE Ministry of Agriculture has issued an Order requiring that no cow or heifer which has calved prematurely shall be sold, exposed at a market fair-ground or sale-yard, or taken to a bull, within two months after such premature calving, except that a cow or heifer may be sold privately or taken to a bull within that time if notice in writing of the premature calving is given to the purchaser or bull-owner before the sale. If that notice is not given, or an animal is taken to market contrary to the provision mentioned, the owner or person in charge of the animal is liable to prosecution under the Order. A further clause of the Order requires that no such animal shall be turned out on any common or unenclosed land or in a field or other place insufficiently fenced. The Order applies to the whole of Great Britain and comes into operation on 1st October, 1921.

The position in regard to this matter is that on 19th January, 1920, the Ministry made an Order enabling Local Authorities to make regulations prohibiting the exposure in a market, or the private sale without notification of premature calving, of any cow or heifer coming within the category mentioned. Most Local Authorities made regulations, and some of those which did not, gave it as their reason that regulations would be of little use unless they were general throughout the country. The Ministry has also received representations from several of the chief Associations and Unions of Farmers in the country, as well as from

many Local Authorities, urging that the Order should be made general and compulsory. The Minister has now taken this step after consultation with his Agricultural Advisory Committee.

It should be mentioned that a successful method of immunising cows and heifers against the disease by vaccination has been elaborated at the Ministry's Veterinary Laboratory. Over 20,000 animals were vaccinated in 1920 in Great Britain.

The vaccine can be obtained by applying to the Chief Veterinary Officer, Laboratory of the Ministry of Agriculture and Fisheries, New Haw, Weybridge, Surrey.

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Seeds Act, 1920: Special Requirements in the Case of Sales of Cereal Seeds.

UNDER the Seeds Act, 1920, it is necessary in the case of a sale of any of the principal kinds of farm and garden seeds for a statement giving certain specified particulars with regard to the quality of the seeds sold, to be delivered to the purchaser at or before the time of sale or delivery. In the case of cereal seeds, however, it has been found that supplies of new seed are required so urgently for autumn sowing that serious inconvenience is suffered by the delay caused in having the necessary test carried out before delivery is effected. The Ministry has therefore issued a general licence authorising the sale of cereal seeds in England and Wales up to the 30th November of the year in which the seed is harvested, without declaring the particulars required under the Seeds Act at or before the time of sale or delivery, provided that such particulars are declared in writing to the purchaser either in an invoice of the seeds, or in some other form, within one calendar month of the sale.*

The particulars required to be stated in the case of a sale of cereal seed are the name and address of the seller; that the seeds have been tested in accordance with the Seeds Act, 1920; the distinctive name of the variety, or if the distinctive name of the variety is not known, or the stock is mixed, a statement to that effect; and the percentage of germination, provided that if the percentage of germination is not less than the authorised minimum in each case, viz., Wheat, 90 per cent., Barley 90 per cent., Oats 85 per cent., Rye 80 per cent., a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

* Copies of the Seeds Act, 1920, and of the Seed Regulations, 1921, may be obtained from H.M. Stationery Office, Imperial House, Kingsway, W.C.2 (price 2d. and 3d. net each respectively).

THE AGRICULTURAL LABOURER IN THE EARLY 19TH CENTURY.

J. L. HAMMOND.

IN the Middle Ages England as a rural society differed little from the other parts of western Europe. The unit of government was the manor. The origin of the manor is the topic of some of the most famous of the controversies of scholars and historians. With those discussions we need not trouble ourselves; it is sufficient for our purposes to note that the men and women living in the villages contained in the manor had certain duties and certain rights. They had to perform certain services in return for which they enjoyed a certain status. Nothing is more important or more interesting in the history of the different nations of Europe than the circumstances under which this ancient society was dissolved. Why, and under what conditions did the peasant survive in certain countries, and why, and under what conditions did he disappear in others? The most illuminating discussion of these historical changes is to be found in the address that Professor Ashley gave to the International Congress of Historical Studies a few years ago. He showed in that address how closely related are these social changes to the type and form of government which was in existence at the time.

France and England.—The contrast can be put most effectively by noting the difference between France and England. In France in the eighteenth century the bulk of the French peasants were customary tenants of one kind or another. They retained a number of obligations from the old feudal system, but subject to these services they held the land they cultivated with some degree of independence. The noble was a courtier rarely living on his estate, and the actual government of the district was in the hands of an official of the Crown known as the *intendant*. The Revolution had two consequences of great importance to the peasant. First and chief it released him with a stroke of the pen from all dues and services that he owed to his lord. That is, he became the unqualified owner of his holding. He was no longer obliged to carry his corn to the lord's mill to be ground, or to pay all kinds of tribute on all kinds of occasion. Further, though rich men bought a great deal of the land that was confiscated when the Church and the emigrant noblemen were dispossessed, a certain amount of that land came into his hands.

If we turn to England we find that the old village was dissolved in a very different manner. The agrarian revolution which began with the conclusion of the 16th century and was in full force between the middle of the eighteenth and the middle of the nineteenth centuries destroyed the village as a society of men with common rights, changing the population from men with rights and property of one kind or another into landless wage earners. Before that revolution, over most of rural England the normal inhabitant of the English village had certain common rights. In many cases he owned a strip of the common fields; in most he had the right to common pasture. At the time at which this society was taken to pieces the government of England was in the hands of an aristocracy which, unlike the French aristocracy, lived on the land, and took an active part in local government. To this class it seemed obvious that the whole system of agricultural life, of which this common field farming was a part, was retrograde. It believed that the agricultural labourer would be more effective than the peasant, that the possession of rights and some degree of independence discouraged men and women from putting forth their best energies, and that the real stimulus to industry was the pressure of poverty. A writer at the time put this view very well when he said that the use of common land by labourers operates upon the mind as a sort of independence, and that among the advantages that would follow the enclosing of the common "the labourers will work every day in the year, their children will be put out to labour early, and the subordination of the lower ranks of society, which in the present time is so much wanted, will be thereby considerably secured."

Enclosures.—With these ideas in the ascendant it was not likely that the rights either of the individual peasant or of the village as a peasant society would be carefully protected in the process of enclosure, or the process by which the individualist farming was substituted for the old confused economy. In truth they were almost wholly disregarded. When an enclosure was carried out by Act of Parliament the procedure was by private Bill. Commissioners were appointed to inquire into local rights and to make the enclosure award. Only two interests were formally and definitely protected in the Bill: the interest of the lord of the manor, and the interest of the owner of the tithe. The individual proprietor and the individual commoner had to make out his case as best he could, and when he received compensation it was often in the form of a small plot of land, unaccompanied by rights of pasture on the common, which he

could only sell because he could not afford the expense of fencing. Of course in hundreds of cases a small commoner could not make out a case at all. He was uneducated and about his rights he knew little, except that as long as he could remember he had kept a cow, driven geese across the waste, pulled his fuel out of the brush-wood and cut turf from the common, and that his father had done all these things before him. It followed, therefore, that in nine cases out of ten on an enclosure the peasant vanished, and the inhabitants of the village became wage earners and nothing more. Thus, when the mediæval village disappeared in France, the various Frenchmen who were called peasants became landowners, where in England they became wage earners.

England and France thus present examples of the dissolution of the old village society under the influence in the one case of aristocratic and in the other case of revolutionary ideas. We might find another contrast in the histories of Prussia and Bavaria. It was thought until lately that Stein and Hardenberg did for the peasant in Prussia what the French Revolution did for the peasant in France. Professor Ashley shows that this view was mistaken. The Prussian peasant was enfranchised on much harsher terms, for the peasants had to surrender from one-third to a half of their holdings to compensate their lords for the loss of their labour services. This operation was carried out at a time when the landlord class was very powerful in Prussia. In Bavaria, on the other hand, the abolition of serfdom and the dissolution of the old system took place in the middle of the last century, and as half the duchy had been in the hands of ecclesiastical bodies down to the nineteenth century, there was not a powerful landlord class, and the peasants were consequently enfranchised on much easier terms.

We may put it broadly then that England got rid of serfdom earlier than the Continent, but that the general conditions on which the mediæval village was finally re-arranged were prescribed by an all-powerful landlord class. This, as Professor Ashley has pointed out, had very important consequences. It is true of almost every society down to the eighteenth century that there were reasons of state for preserving the peasantry and reasons of class interest for dissolving it. Mr. Tawney's brilliant book on "The Agrarian Problem in the Sixteenth Century" shows these motives in conflict in the struggles over the enclosures of that age. The interests of peace, defence, order, and revenue all demanded in the eyes of prominent statesmen at that time (as they demanded in the eyes of a continental ruler like Marie Thérèse or Frederick William the Third of

Prussia) that the peasantry should not be torn from the soil; the commercial interests of a powerful class pulled in the contrary direction. At the time of the 18th century agrarian revolution in England there was no such conscious conflict. The landlord class which controlled the Government saw no antithesis between the reasons of state and the reasons of class interest. In their minds public policy and private interest pointed the same way. Their power was absolute and they used it to destroy a village society which seemed to them barbarous and obsolete. The ideal village in their view was not a society linked together by a system of common rights, but a society in which the squire was supreme, the greatest encouragement was given to the application of capital to farming, and the actual tilling of the soil was carried out by a proletariat.

Sir John Sinclair, first President of the Board of Agriculture of that time, said what most enlightened people thought: " The idea of having lands in common, it has been justly remarked, is to be derived from that barbarous state of society, when men were stranger to any higher occupation than those of hunters or shepherds, or had only just tasted the advantages to be reaped from the cultivation of the earth." And almost every enlightened person would have agreed that the worst thing to do in reforming this barbarous system would be to turn the man who worked on the soil into an owner. McCulloch, the celebrated economist, predicted that in half a century France would pay for her blunder in this respect by finding herself " the greatest pauper warren in Europe."

There was a sense, of course, in which it was quite true that the interests of the class in power were identical with the interests of the nation. Lord Ernle has shown in his judicial survey of the problem in his classical history " English Farming Past and Present," that the old common field system, as it was conducted, could not have met the growing and urgent needs of the English people. The French War and the industrial revolution, coming together, changed the balance and problem of English economic life. There was the pressure of a great emergency, throwing England on her own resources: there was the rapid increase of population in industrial towns that produced no food. England had to make her soil more productive or starve. This need accelerated the process of enclosure. If this problem had not arisen England might have remained for another generation the kind of society for which Dean Inge cherishes such regrets, as readers of his book, " Outspoken Essays," will remember, and the extinction of the old village

society would have been a slower process. Reform was essential, not merely for the sake of the future, for reform of that kind is commonly neglected till the crisis comes, but for the immediate wants of the moment. And reform is difficult in peasant societies where men look to the past more than to the future, and honour custom more than science, piety more than enterprise.

Leadership of Landlords.—It was true also that the leadership the landlords claimed was justified as a rule by their services. Not only were they, in contrast to the French aristocrats, men of great public spirit, who served their counties and their villages with devotion and industry: they were in notable instances the pioneers of the great improvements that marked this phase of English agriculture. It would be difficult to name a Cabinet Minister of the time, Pitt and Fox excepted, who counted for so much in the life of the England of that time as Coke of Norfolk. Here was an opportunity and the men to seize it, a crisis and the men to meet it. One reason why enclosure bills went through Parliament with so little scrutiny was that the advantage of putting agriculture under the direction of men with capital, knowledge and foresight and of removing every obstacle to their exertions were so self-evident that the details seemed to possess in comparison very trifling importance. One speaker put it in the House of Commons that he supported every enclosure bill as a matter of course because enclosures could not be too rapid or too sweeping.

Evils of the Revolution.—Unfortunately the social evils of this revolution were not less striking than the economic advantages. For the enclosures carried out in this spirit, with or without an Act of Paliament, spelt ruin to the poorer classes who took part either as small farmers or as cottagers and labourers in the economy of the old village. The great majority received nothing under the enclosure awards: those who did receive an allotment could not as a rule put it to any use either because they could not afford to fence it or because it was valueless without a right of pasture on the common. Of the men who were dispossessed some emigrated to America and some to the new industrial towns, where they supplied the new industrial system with enterprise or with labour. Some of the chief names in the history of the cotton industry, Peel and Fielden among them, take us back to an enclosure. But the great majority remained in their villages, sinking into the position of a labourer without rights. The great bulk of agricultural work was now carried on for the first time by men without any rights on the soil. Few of the enthusiasts for enclosure foresaw all the

consequences of this momentous change or realised that some provision must be made for it. As it happened, the event that forced this problem on the public mind was the event that had accelerated enclosure. The French War brought recurring spells of scarcity and famine prices, and during the French War the harvests were as a rule poor; in particular they were disastrously bad in the years 1795, 1799 and 1800.

Degradation of English Life by Doles from the Rates.—The year 1795 therefore marked an important crisis. The labourer had raised a good part of his own food under the old system and he had never been dependent entirely on his wages. He had now lost his cow, his geese, his fuel, and he had to rely on his wages. buying at the shop or from a farmer who was not always anxious for his custom, the food he had formerly produced himself. Thus scarcity and high prices hit him much harder than they would have hit him under the old system. By 1795 his wages no longer supported him. Something had to be done unless he was to starve. Some observers argued that the right policy was to set up a minimum wage. Arthur Young was himself in favour of this plan and it was supported by two clergymen who had great knowledge of the state of the villages and great and wise sympathy with the unfortunate labourers. One was Howlett, the Vicar of Dunmow, and the other Davies, the Rector of Barkham in Berkshire, the author of a singularly interesting and illuminating book called "The Labourer in Husbandry." The proposal was taken up by Whitbread in Parliament, and it had the support of Fox and Grey, but it was rejected at the instance of Pitt who denounced it as economically unsound. The plan adopted in its stead is famous in history as one of the capital causes of the degradation of English life in the first thirty years of the nineteenth century.

This method takes its name from Speenhamland, now part of Newbury, where a meeting of Berkshire magistrates was held at the Pelican Inn, on 6th May, 1795, to consider the problem. The Chairman of the meeting, Charles Dundas, the Member for Berkshire, afterwards Lord Amesbury, who was in the chair, was in favour of using the power given to the magistrates by the Act of Elizabeth to fix wages, but he was defeated and the meeting decided instead to adopt a scheme for supplementing wages from the rates on the plan that soon spread to other counties. The resolution that was passed may be given:—

"Resolved, that it is not expedient for the magistrates to grant that assistance by regulating the wages of day labourers according to the directions of the Statutes of the 5th Elizabeth and 1st James: But the

Magistrates very earnestly recommend to the Farmers and others throughout the county to increase the Pay of their Labourers in proportion to the present Price of Provisions: and agreeably thereto the Magistrates now present have unanimously Resolved, that they will in their several Divisions, make the following calculations and allowances for the relief of all poor and industrious men and their families, who, to the satisfaction of the Justices of their parish, shall endeavour (as far as they can) for their own support and maintenance, that is to say, when the gallon loaf of second flour, weighing 8 lbs. 11oz. shall cost one shilling, then every poor and industrious man shall have for his own support 3/- weekly either produced by his own or his family's labour or an allowance from the poor rates, and for the support of his wife and every other of his family 1/6. When the gallon loaf shall cost 1/4 then every poor and industrious man shall have 4/- weekly for his own and 1/10 for the support of every other of his family. And so in proportion as the price of bread rises or falls (that is to say) 3d, to the man and 1d. to every other of the family on every penny which the loaf rises above a shilling."

On the same day the Mayor of Basingstoke presided over a meeting in that town at which a resolution was adopted in favour of fixing wages rather than making doles on this principle from the rates, but it was the dole system that won in the country and by 1834 it was in force everywhere in England except in the two counties of Durham and Northumberland.

The Poor Law of 1834.—The dole system lasted till 1834 when it was abolished by the new Poor Law. By that time it was generally condemned on the sufficient grounds that it was bringing the parishes to bankruptcy and the labourers to hopeless improvidence. The Report of the Commissioners on the Poor Laws gave several examples of the first of these results. The expenditure in Slaugham with a population of 740 was £1,706. " This large sum was spent principally in orders on the village shop for flour, clothes, butter, &c. The tradesmen serve the office of overseer by turns: the two last could neither read nor write." The effect of the system in destroying all motives for thrift in the labourer was obvious, for it meant in practice that only men who were qualified to receive relief as paupers were eligible for employment. A witness before the Poor Law Commission of 1834 told the following story:—

"The case of a man who has worked for me will show the effect of the parish system in preventing frugal habits. This is a hard working industrious man named William Williams. He is married and had saved some money to the amount of about £70, and had two cows: he had also a sow and ten pigs. He had got a cottage well furnished: he was a member of a benefit club at Meopham, from which he received 8s. a week when he was ill. He was beginning to learn to read and write and sent his children to the Sunday school. He had a legacy of about £46 but he

got his other money together by saving from his fair wages as a waggoner. Some circumstances occurred which obliged me to part with him. The consequence of this labouring man having been frugal and saved money, and got cows, was that no one would employ him, although his superior character as a workman was well known in the parish. He told me at the time I was obliged to part with him: 'Whilst I have these things I shall get no work: I must part with them all: I must be reduced to beggary before anyone will employ me.' I was compelled to part with him last Michaelmas: he has not yet got work, and he has no chance of getting any until he has become a pauper: for until then the paupers will be preferred to him."

A man who had any property, if it was savings or a cottage or a few animals, could not receive help from the rates: a man who did not receive help from the rates could not get any farmer to employ him. The Poor Law designed to help had become a vicious circle from which the poor man could find no escape.

The Roundsman System.—In the old village there had been a number of persons who were partly farmers and partly labourers. There were again a number of labourers who when employment was scarce could find work to occupy themselves, in collecting fuel, cutting turf and looking after their live stock. A good many observers, reflecting on the great stimulus that might be given to agriculture by organisation, concentration, and the proper division of labour had regarded this kind of dual life as a great obstacle. Under the Speenhamland system the labourer was deprived not merely of these aids to independence but of any power to bargain for himself about his labour. He had to take any wage that the farmer chose to give him and to receive the rest of his subsistence from the parish in a form that made him a kind of serf. An Act of Parliament known as Gilbert's Act, passed in 1782, had introduced a system, called "the roundsman system," by which the parish distributed unemployed labourers among the parishioners, the parish paying two-thirds of their wages, and the employer one-third. By the Speenhamland system every labourer became a pauper in the sense that his wages were eked out by a dole from the rates.

If a labourer was in private employment, the difference between the wage his master chose to give him and the recognised minimum was made up by the parish. Those labourers who could not find employment were shared out among the ratepayers or else their labour was sold to employers by the parish at a low rate, the parish contributing what was needed to bring the labourers' receipts up to scale. The roundsman system has been described by Crabbe:—

"Alternate masters now their slave command
Urge the weak efforts of his feeble hand,
And when his age attempts its task in vain,
With ruthless taunts, of laxy poor complain."

Under this plan the depression of wages was inevitable. During the war the plan seemed to work because prices were high, farming was exceedingly profitable and unemployment not very general. After the peace came, however, it was no longer possible to absorb the redundant labour, with a population increasing rapidly, in this wasteful roundsman system. In Buckinghamshire in 1828 wages were 3s. a week for single and 6s. a week for married men, and witnesses from different parts of the country gave the same accounts of wages that were far below subsistence level. The only exceptions were the counties in the North where the Speenhamland method had not been applied. The strain on the parish system became acute and it was met by reducing the subsistence scale. In a report of the old Board of Agriculture we have an account of the scale fixed in Northamptonshire in 1816 and it shows a decline from the scale fixed at Speenhamland in 1795. We have another scale in the Report of the Committee on the Poor Laws which shows that in Wiltshire in 1817 a man was allowed little more than half of the allowance of 1795. In Hampshire and in Dorset scales were fixed in 1822 and 1826 that mark a further drop, and in his "Political Economy," published in 1825, McCulloch says. "The allowance scales now issued from time to time by the magistrates are usually framed on the principle that every labourer should have a gallon loaf of standard wheaten bread weekly for every member of his family and one over: that is four loaves for three persons, five for four, six for five and so on." Thus we see that the standard of subsistence had fallen by fifty per cent. between 1795 and 1825, or we may say that a man and his wife in 1825 were allowed only as much as a single man in 1795. That of itself would be sufficient evidence of the deterioration in the circumstances and prospects of the labourer. Yet, to understand fully his bitterness we must recollect that the labourers who were now sent on their roundsman job or, as in some cases, put up to auction in the parishes, had often known what it was to be independent men living not altogether on wages but on their own resources as small farmers or cottagers with common rights, and that almost all of them inherited the traditions of such a life.

The Game Laws.—There was not a uniform administration of this system and the practice varied in different districts. In

many cases, only the wages received during the last week or fortnight were taken into account, and thus the allowance would be paid sometimes to persons who were not in need. This accounts for the fact stated by Thorold Rogers that there were labourers who actually saved money under this system, but generally speaking it was true that it was impossible to maintain life on the allowance fixed in the years after the war. In this extremity the labourers kept themselves and their families by poaching. At no time since the old forest laws were passed by the first Norman Kings has poaching been so important an element in English life as it was in the first thirty years of the nineteenth century. One witness before the Committee on the Game Laws said that in a village of which he knew the whole village poached, the constable included. The Duke of Richmond stated in the House of Commons that one in seven of the criminal convictions of the country in the years 1827-1830 were convictions under the Game Laws. The number of persons so convicted was 8,502, many of them being under eighteen. Cobbett tells us that a gentleman in Surrey asked a young man who was cracking stones on the road side, how he could live on half a crown a week. "I don't live on it," he said. "How do you live then?" "Why," said he, "I poach: it is better to be hanged than to be starved to death."

The Visiting Justices of the Prisons in Bedfordshire reported in 1827 that more than one-third of the commitments during the last quarter in that county had been commitments for offences against the Game Laws. "In many parishes in this county the wages given to young unmarried agricultural labourers, in the full strength and vigour of life, seldom exceed 3s. or 3s. 6d. a week, paid to them generally under the description of roundsmen, by the overseers out of the poor rates: and often in the immediate vicinity of the dwellings of such half-starved labourers there are abundantly stocked preserves of game, in which, during a single night, these dissatisfied young men can obtain a rich booty by snaring hares or taking or killing pheasants." It was in consequence of the steady increase of poaching amid the great distress of the time that the Game Laws were made more and more drastic until our code became in some respects the most severe in Europe.

Schemes for Improvement of the Conditions of Labour.—It must not be supposed that the governing class was indifferent to all this wretchedness and poverty. The speeches of landowners in both Houses of Parliament are full of laments about

it. Karl Marx, a bitter critic of the England of those times, admitted that there was one respect in which England set a good example: she was continually holding inquiries and publishing facts about her social problems. At this time there were frequent investigations into the Poor Laws and the Game Laws, and Parliamentary committees were constantly trying to find out what was the matter. The truth was that under the influence of a great economic stimulus and a great national danger Parliament had carried out a revolution which had had beneficent consequences in increasing the food resources of the country at a time when that increase was urgently needed, and it was quite helpless in the face of these unexpected results. This sudden and perplexing social problem bewildered most people. In the back of their minds they believed it insoluble.

Remedies were suggested by men of experience and knowledge. Such were Eden, Arthur Young, Cobbett, and Lord Suffield, all of whom at different times proposed schemes for providing labourers with cottages and allotments. All these schemes assumed, in opposition to the general notion of the time, that independence was not a bad but a good influence in a man's life: acting as a spur to his industry and thrift. Arthur Young proposed that twenty millions should be spent in endowing half a million families with cottages and allotments: the fee simple to be vested in the parish, the cottage and land to revert to the parish if the father or his family became chargeable to the rates. The proposal was made at a time when a General Bill for facilitating and cheapening enclosure was before Parliament. Young made the proposal because in his travels about the country he had been appalled by the general avalanche of pauperism under which the villages were sinking, and he noticed that wherever there were cottagers who had kept together a little property or retained their rights of pasture they had escaped the common fate. His pamphlet is a moving document, showing how painful an impression the scenes he had witnessed had made on his mind. He was supported by Sir John Sinclair, the first President of the old Board of Agriculture, but the Board was now in other hands and though Young was Secretary the publication was private and not official. It was Young's hope that the General Enclosure Bill, then before Parliament, would be amended in order to make provision for cottagers in future enclosures, but his hope was disappointed. Cobbett sketched a similar plan in a letter to William Windham, published in his Political Register; and Lord Suffield, well known for his noble exertions as a Prison Reformer, tried in vain to get Lord Grey's Govern-

ment to adopt this policy in 1831 after the riots of the winter of 1830 and their terrible punishment. Up and down the country there were individual landowners and individual parsons who managed to introduce schemes of this kind into enclosure Bills or into the administration of particular estates, generally with most satisfactory results, but the general opinion in enlightened circles was unfavourable.

For the teaching of Malthus was in fashion and most people argued that any reform of this kind would stimulate the increase of population in which they saw at once the great mischief and the great danger of their age. The drastic surgery of the Poor Law of 1834, described by Thorold Rogers as "necessary, inopportune and unjust," represented the views of the majority of the time; the school known as the "Vice and Misery" school because it held that it was only by these terrible agents that Nature prevents man from increasing faster than his food. A powerful attack was made on that creed by Michael Sadler, the Tory Member for Newark, chiefly known as the leader of factory reform, in the House of Commons in 1831, in a speech that contains a most interesting review of the agricultural conditions of the time.

A monumental volume has lately been published by a Cambridge scholar describing the different types of agricultural society that are to be found in the records of classical literature. Mr. Heitland traces in this book "Agricola" the development of Latin farming through its different phases. We see the small farmer, the man who fought the early wars of the republic, working with a small staff of domestic slaves. He gives way to the great capitalist farmer who employs the slaves that were swept into Italy from all the populations that were conquered by Roman arms. These unhappy exiles lived in "ergastula" and we think of them chiefly in connection with the exploits of Spartacus, the Thracian, who led his fellow slaves to a short-lived victory over Roman armies. Then there comes a check to this process because the slave supply from this source declines under the Empire and the work of cultivation is done by Roman coloni, tenant farmers. As their embarrassments and difficulties grow, these men lose their status and sink to the position of serfs. Thus in all ages we are confronted with this same problem, of finding under what type of human society agriculture can best serve her two great purposes, as the source of food and the mother of men. In that tormenting tragedy the history of the English labourer in the years that followed the great struggle with Napoleon makes a significant episode.

IMPROVEMENT OF DAIRY CATTLE IN DENMARK.

HARALD FABER,
Agricultural Commissioner to the Danish Government.

IN the year 1920 the Danish Milk Recording Societies celebrated their 25th anniversary, the first Society, at Vejen, Jutland, having started operations in 1895. The Associated Danish Agricultural Societies marked this jubilee by publishing a report containing a series of articles describing the various features of the development during these 25 years. One of the articles, by Johs. Petersen-Dalum, the son and now the successor of the founder and director of the Dalum Agricultural and Dairy School, deals with the Influence of Milk Recording on the Breeding of Dairy Cattle. The following remarks are based chiefly on that article and on a paper read in January, 1919, by Peter Aug. Mörkeberg (Live Stock Commissioner to the Danish Government) on "The Cattle Breeding Societies in Funen during 25 years." I am also indebted to Mr. Mörkeberg for various hints and additional information.

The aims of the first Society, "Vejen Kontrolforening,"* were to ascertain the quantity and quality (percentage of milk fat) of the milk yield of individual cows, the amount of fodder consumed, and the relation between yield of milk and consumption of fodder. The sphere of action of the Danish Milk Recording Societies have since been stated to be :—

1. The Societies ascertain the yield of milk and of butter and the increase in live weight obtained from 100 food units;
2. They estimate the value of the animal as a producer and offer the chief guide when selecting animals for breeding;
3. They induce farmers to keep accounts of farming;
4. All branches of farming should gradually be included in the operation of the Societies;
5. The Record-keeping is done in the cheapest manner by forming special Societies for the purpose.

The first object of milk recording. the importance of which should be readily understood by all dairy farmers, is to discover those cows in the herd which produce too little milk and butter

* The reason why Danish Milk Recording Societies are called "Control Societies" is given on page 110 in my book, "Co-operation in Danish Agriculture," 1918: Longmans, Green & Co.

to pay for the fodder consumed and which are therefore kept at a distinct loss to the farmer and to the country. When the Vejen Society had been working for one year a report was published in which it was shown that the best cow belonging to members of the Society produced a pound of butter at the cost of 6d., while the poorest cow produced a pound at the cost of 2s. 8d.! Cows like the latter should, of course, be fattened off and killed as soon as possible.

Of even greater importance, however, is the help or guidance which the results of milk recording offer the farmer in his efforts to breed dairy cattle for milk production. This was seen clearly by the men who started the movement in 1895; indeed, the desire to obtain reliable information on which to base the breeding of cows with a large yield of rich milk was the chief reason which induced the farmers to form the Vejen Society. By 25 years' work the milk recording societies have gradually secured a hitherto unknown reliability in the breeding of dairy cattle. By recording the yield of milk and butter the farmer would learn not only which cows should be got rid of, but which were the "butter cows," cows yielding a large amount of milk and butter fat, and these he would use preferably to breed from. In the by-laws of many of the Danish Control Societies, or Milk Recording Societies, the principal aim is stated to be "based on records of the yields of milk as to quantity and quality, and of the fodder consumed, to determine whether the keeping of dairy cattle yields a profit, and *to help to form strains of dairy cattle producing an increased yield of butter.*" The Danish Government has in various ways helped cattle breeding by grants. By the Law of 1902 on Breeding of Domestic Animals the Government granted £6,700 to the Milk Recording Societies on condition that "the Society should have for its aim to make dairy farming more profitable by examining into the feeding of the individual cows and their yield of milk by quantity and quality, and *to help to form strains of dairy cattle producing a higher yield of butter.*" The grant was renewed by the Law of 1912, which reduced or withdrew most other grants to cattle breeding. The milk recording society should have at least 10 members with 200 cows, and the grant to each society was not to exceed £10.

When Danish farmers, in the 'seventies and 'eighties of last century, gradually learned to appreciate the importance of dairy farming they tried to improve the yield by better feeding and better selection of animals for breeding. The means of judging the cattle, at shows and at home, were restricted to a considera-

tion of their exterior, their build, so-called milk sign, such as size of udder, Guenon's mirror and so on. Only a few prominent breeders knew anything about the *yield* of milk of their cows, none knew about the *richness* of the milk. Breeders suffered not only from the uncertainty in the valuation of the individual cow as a milk producer, but they were also uncertain as to the ability of the cow to transmit her character as a milk producer to her progeny. Even more difficult was the selection of the male animal with a view to improved yield of milk.

The milk recording societies brought about a change by enabling the best productive cows to be picked out. The study of the milk records was bound to cause an increase in the average production, by eliminating the bad milkers and by breeding from the good milkers. Concurrently a more liberal feeding was adopted, the fodder being apportioned between the cows in proportion to their yields. Because of the influence of the better feeding it is impossible to say exactly what was the influence to be ascribed to the milk recording societies, but the influence of the general improvement in methods of breeding and rearing of dairy cattle is easily perceptible. Take, for example, the figures in the following table calculated from the records of the milk recording societies in Funen. In 1909 the total number of cows and of heifers which had calved in the island of Funen was 153,500. The following average figures are calculated from the *records of all cows* belonging to members of the milk recording societies, whether in milk or not, whether in calf or not:—

Year.	*Number of cows.*	*Yield of milk.*	*Percentage of fat.*	*Yield of butter.*
1899–1900	5,467	6,822	3·36	255
1902–03	17,662	7,410	3·41	282
1905–06	33,903	7,240	3·47	279
1908–09	40,788	7,473	3·49	290
1911–12	30,757	7,667	3·52	301
1913–14	41,591	7,832	3·52	308
1915–16	40,116	7,938	3·55	323

Similar results were obtained in other districts, but showing a slightly smaller increase than for the societies of Funen. In judging these figures it should be borne in mind that for the different years they refer to different animals, and particularly that every year there are included new herds which have not been previously tested. The progress in individual societies, and still more in individual herds, is often very much greater.

Family Herdbooks.—It is the general rule in Danish dairy farming that the farmer breeds his own cattle. He will select

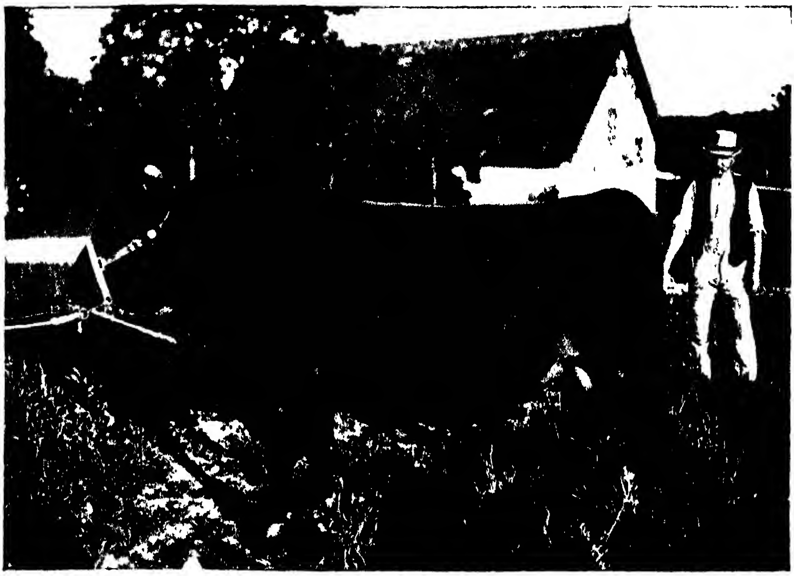


FIG. 1 — Bull of Red Danish Dairy Breed, "Dan" (Herdbook 450).
Owner Grut Hansen, Kollekolle.
27 Daughters of "Dan" yielded on an average during the year 1912-1913 11,235 lb. of Milk, 3·89 per cent. of Fat, 188 lb. of Butter.

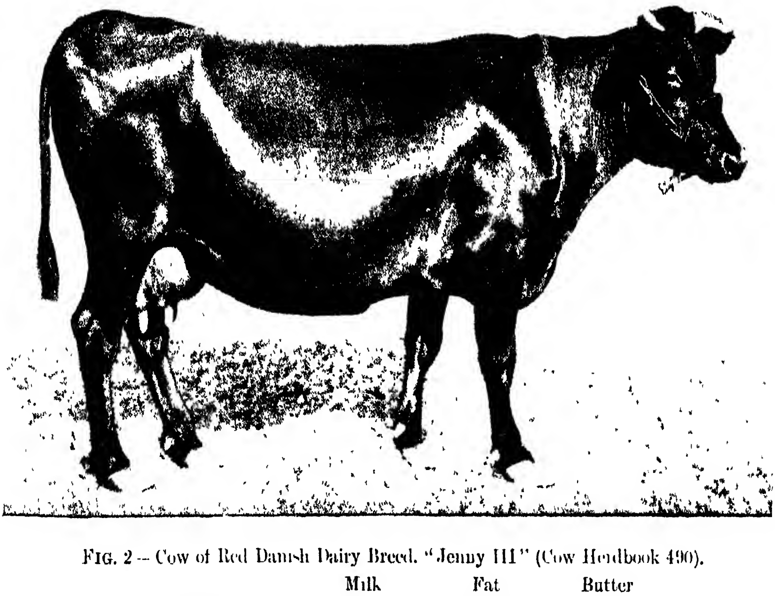


FIG. 2 — Cow of Red Danish Dairy Breed. "Jenny III" (Cow Herdbook 490).

Yielded		Milk lb.		Fat per cent.		Butter lb.
1914–1915	...	10,527	...	4·81	..	570
1915–1916	...	14,128	...	4·58	...	728

FIG. 3. Bull of Jutland Breed, "Silva Hannibal" (Herdbook 2218),
5 years old when photographed.
Owners: Sattrup-Monbjerg Cattle Breeding Society.
Average annual yield of Dam for 3 years 10,187 lb. of Milk 3·55 per cent. of Fat 403 lb. Butter.

FIG. 4.–Cow of Jutland Breed, "No. 17. Marie IVa" (Herdbook 117).
Owner: Johs. Overgaard, Stautrup.
Average annual yield during 9 years. 10,222 lb. of Milk, 3·92 per cent. of Fat, 417 lb. of Butter.

from among his cows the healthy and well-built animals giving the highest yields, and breed from these, and in order the better to secure these characters in the progeny he will use in-breeding or line-breeding, and thereby form *families*. It is not enough for him to know that the cows he breeds from have the productive qualities he desires to find again in the progeny; it is equally or even more important that he should know whether the cows have the ability to transmit these qualities to the progeny, either female or male. *The greater the number of high yielding animals a cow can count among her ancestors the more likely she is to pass on the quality of high yield to her progeny.* It therefore became of the greatest importance to farmers to know as much as possible about the descent of their dairy cattle, and for this reason *family herdbooks* were introduced, and the value of these depends to a great extent on the work of the milk recording societies. These family herdbooks are a special Danish feature, and are now kept by about 2,000 breeders, naturally including the very best of them.

Private herdbooks were kept by a few prominent breeders as far back as the sixties of last century, with the object of breeding cattle true to race or breed. The *Family Herdbook* is an invention of Mr. Mörkeberg, or rather, it is the result of his idea of putting into practical shape what he had learnt from prominent breeders in Great Britain during his early visits. Breeders spoke to him about "families" or "tribes" within their herds, and by families they meant the descendants from a certain cow tracing the descent only through the female side. These families differed from one another in certain characters. It was easier to keep in one's mind a picture, so to speak, of a large herd, when the animals in it were grouped in tribes or families. This led Mörkeberg in 1891 to draw up a family herdbook for the large and excellent herd of dairy cattle at Ourupgaard, belonging to Mr. Tesdorpf, who had kept records of the milk yield of his cows since 1860. The milk records were entered for each cow in the family herdbook. At that time there was no practical means of estimating the richness of the milk. These family herdbooks acquired an additional value for the breeding of dairy cattle for milk production from the time when the milk recording societies furnished reliable information on the yield of milk of individual cows by quality as well as by quantity, which information is noted in the herdbooks. Further, the milk recording societies did not restrict their action to furnishing figures for yield: they made the headings in their journals comprise all the information required for the family herdbook.

Following are two specimen pages of the Bood of Record Sheets used by the Milk Recording Societies of Funen, giving, in the headings, the particulars of breeding, and below, the milk record of the cow for the year 1919-20, the latter being here condensed and translated into English weights and measures.

LEFT PAGE:

Year 1919/20. Cow No. 7. Name: Frigga VIII. *(Continued on right page).*

Sire: *Kristoffer Damgaard. Herdbook No. 1,266. Born 21/9/09, on the farm of Fr. Hansen, Damgaard.

Dam: No. 13, Frigga V. Herdbook . Born 26/8/07, on the farm of A. Nielsen, Norremosegaard Kvœrndrup.

Winter term, 1 Oct., 1919, to 30 Apr., 1920.

On this page are entered details of nine milk records: date, weight of milk, and percentage of fat. From these are calculated: total weight of milk, and of butter, and number of kg. milk with one per cent. of fat, for each period covered by a record, the period having as far as possible an equal number of days before and after the day when the milk record was taken. The number of food units of fodder consumed are also entered, specifying cakes, other concentrates, roots, hay, straw, grass and green crops, and total food units.

The totals on the specimen page for the winter term of 7 months are:—

Days in Milk.	Yield of Milk.	Yield of Butter.	Pounds of Milk with 1 °/₀ fat.	Days of feeding.	Total food-* units consumed.
	lb.	lb.			
194	13,045	583	52,132	213	5,957

RIGHT PAGE.

(Continued from left page.) **Born 3/10/12,** on the farm of A. Nielsen, Norremosegaard, Kvœrndrup. **Herdbook of Cows:** No. 892.

Calved last year: 27/10/1918.
Calved this year: 19/10/1919.
Sire of calf: Kristoffer Lunde II; born 1/9/16. Sex: Bull calf; Marked No. 7. How disposed of: reared.

Summer term, 1 May to 30 Sept., 1920.

Similar particulars from 8 records taken during summer to those on the previous page for the winter term.

Total result for the year.

Yield of Milk.	Per cent. of fat.	Yield of butter.	Pounds of milk with 1 °/₀ fat.	Days of feeding.	Food-units consumed.*
lb.		lb.			
19,319	3·90	841	75,250	366	8,860

* Taking 1 lb. of barley as the unit.

The controller and the farmer himself must fill in these headings, giving full particulars of the cow whose yields are entered on the pages below, of her sire and dam, her calf for the year in question and the date of service. By helping farmers to get these particulars, on which the drawing up of the family herdbook depends, carefully noted in the milk recording journals, the milk recording societies therefore offer an essential and practical help to breeders of dairy stock, and a considerable agitation to get more and more farmers to keep family herdbooks has been carried on by the milk recording societies.

The family herdbooks are not drawn up by the controller of the milk recording societies but by the more responsible Agricultural Advisers who are appointed, in order to help those farmers who apply to them, by the agricultural societies or the joint committees of breeding societies and milk recording societies. The State defrays part of the salaries paid to these advisers.

Official Herdbooks.—In the 'eighties official herdbooks were started, and these are to some extent based on the family herdbooks. and since milk recording societies became general the official herdbooks give information of the yield of the animals; in the case of herdbooks of bulls the yields of milk, percentage of fat and calculated yields of butter are given for each recorded year for dam, dam's dam, and so on, as far back as the information is available.

The Herdbook for Cows of the Red Danish Dairy Breed in Funen was begun in 1904. Only cows from herds with family herdbooks can be entered, and they must give above a certain minimum yield and belong to good families of dairy cattle. Six volumes, comprising 941 cows, have been published and are a valuable help to farmers wishing to buy bulls. The following table giving the yields of dam, dam's dam and sire's dam of bulls bought by the Cattle Breeding Societies* in Funen shows this better than many words.

Average Yields of Dams, Dams' Dams, and Sires' Dams of Bulls bought by Cattle Breeding Societies in Funen in different years :—

Year.	Dams.			Dams' Dams.			Sires' Dams.		
	Milk.	Per cent. Fat.	Butter.	Milk.	Per cent. Fat.	Butter.	Milk.	Per cent. Fat.	Butter.
	lb.		lb.	lb.		lb.	lb.		lb.
1905–06 ...	9,244 ...	3·59 ...	367	9,137 ...	3·53 ...	365	9,038 ...	3·67 ...	372
1908–09 ...	8.525 ...	3·75 ...	383	9,475 ...	3·55 ...	374	9,473 ...	3·74 ...	394
1911–12 ...	9,339 ...	3·95 ...	414	9,271 ...	3·76 ...	387	9,381 ...	3.75 ...	389
1914–15 ...	9,326 ...	3·94 ...	403	8·875 ...	3·81 ...	376	9,581 ...	3·73 ...	420
1917–18 ...	8,802 ...	4·11 ...	407	9,172 ...	3·92 ...	400	9,350 ...	4·13 ..	431

* On Cattle Breeding Societies or Bull Clubs, which are quite distinct from "Breed Societies," see the writer's book "Co-operation," p. 85.

In the 'nineties Danish farmers used to speak of "butter cows," at shows special classes were reserved for "butter cows," and certain herds or strains were spoken of as "butter strains." These terms are no longer in use, development having rendered them unsuitable. From the more elementary question as to the amount of milk and butter produced by a cow, attention was directed to the more important but also more difficult question whether the cow was able to transmit her high-yielding capacity to her progeny.

Prizes for Herds.—One way in which a solution was sought was by means of *competitions between entire herds*. Certain competitions had already been carried out in Funen in the 'eighties for one year at a time. Their object was to find herds which not only contained prominent animals but consisted of families of such, and from which a supply of good breeding animals could be obtained for the improvement of other herds.

When, in 1894, the Gerber method of estimating the percentage of fat in milk was introduced the leading cattle breeders in Funen wanted this item included in the judging, and they wanted the competitions carried on for two whole years. A new series of competitions between entire herds in Funen was therefore begun in 1894 and another similar series began in 1897 in Sealand. Each of these competitions was carried on for two whole years, during which time the competing herds were visited about six times each by a Committee of Judges, while young men were engaged to assist the judges by visiting each of the farms every twentieth day throughout the period, weighing and analysing the milk, weighing the fodder given to each cow, and making the requisite entries in the family herdbook. The family herdbooks in their fully developed form may be said to date from these biennial competitions. All the herds entered for the seven competitions in Funen and in other provinces had such family herdbooks made for them.

The first competition in Funen was in 1894-96, the seventh was held 1913-15. The herds were judged according to yield of milk, both by quantity and quality, and yield of butter (calculated from the yield of milk and percentage of fat), together with records of amount of fodder consumed and records of descent of and relationship between the animals. The best herds were awarded prizes and were officially recognised as "Breeding Centres."

The recording of yield of milk and butter and of fodder con-

sumed introduced into these competitions followed the lines which were afterwards adopted by the milk recording societies. The first two-year competition in Funen, begun on 1st October, 1894, therefore constituted in a way the first milk recording society. On the other hand it was the records obtained by the milk recording societies which in the following years enabled the various breeders to decide whether their herds stood any chance if entered in these competitions. The milk recording societies, therefore, in a way, may be said to have performed the preliminary sorting of the herds to be entered for the later competitions.

As indicating the progress in the breeding of dairy cattle the following table is of interest, as it gives the average results of yields of the herds entered in the first, fourth and seventh two-year competitions in Funen. There were entered at these three competitions 7, 18 and 10 herds respectively, covering 530, 777 and 304 cows respectively. The results are the average for *all cows*, including heifers, cows that did not calve during the two years, and cows not in milk.

	Yield of Milk.	*Percentage of Fat.*	*Yield of Butter.*
	gal.		lb.
1. 1894–96	697	3·44	266
2. 1903–05	853	3·53	334
3. 1913–15	934	3·83	398

These two-year competitions between entire herds comprising all the cattle on the farms are a special Danish feature. They were in 1897 acknowledged to be of so great importance that the Government gave an annual grant of £4,000 for four years, of which as much as £150 a year could be paid to the best breeding centres. This was an encouragement in a double sense. It was a reward to the good breeder, and it showed the farming world in general how much importance the Government attached to these competitions. Many more herds were therefore entered, and the State Grant became superfluous and was withdrawn except so far as to cover the cost of the administering the competitions.*

Milk Yielding Capacity Inherited Through Bulls.—The investigations had so far been restricted to the yield of cows. It had been proved by the records of the milk recording societies, coupled with the family herdbooks, that the character of high yield was hereditary and could be transmitted from the cow

* Peter Aug. Mörkeberg: "The Danish System of Cattle Breeding," this *Journal*, March, 1910, p. 1001.

to her progeny. The next step forward, and a most important advance, was made when it was ascertained from the records of the milk recording societies that the capacity to yield large quantities of milk having a high percentage of fat could also be passed on through the bull to his progeny with different cows. The bull, as it is truly said, is half the herd. It therefore became of the first importance to find which bulls had a beneficial and which an adverse influence in respect of yield of milk and butter, *and particularly so if this knowledge could be obtained while the bull was still alive and in vigour for breeding*. This, fortunately, could be done, because before the inauguration of milk recording societies it had already become a general practice to keep bulls for service for a number of years, and even as far as it was then possible, *to judge the bulls by an examination of their offspring*.

By the Law on Breeding of Domestic Animals, of 1887, the Government made an annual grant of £1,500 for prizes for bulls at District Agricultural Shows, to be awarded only to bulls more than three years old. By the Law of 1902 the amount was increased to £3,750 for prizes to be awarded at "State Shows."* It was a condition that the bulls for which prizes were awarded were to be kept for service in the country at least until 1st May in the following year. It was a further condition that bulls five years old or older should be judged through their offspring. Special shows of the offspring were to be held before the State Shows according to the following rules:† for bulls five years old or older, which had been serving in the district for at least $2\frac{1}{2}$ years, ten descendants must be shown; for bulls above six years of age, 3 years in the district, twelve descendants; for bulls above seven years of age, 4 years in the district, fourteen descendants; the young stock must be at least one year old and three of them may be bulls; of descendants of bulls over six years of age, three, and for bulls over seven years of age four must be

* A special Commission is appointed by the Minister of Agriculture to manage the State Shows for Stallions four years old or older and for Bulls three years old or older. The country is divided into 13 Show-districts. In each district is a Committee for Stallion Shows and another for Bull Shows. The Agricultural Societies appoint the other members, generally two to each of these Committees, and the Minister appoints the Chairman. The Chairmen of these Committees, together with the Government Live Stock Commissioners, form the State Show Commission under a Chairman appointed by the Minister. The Government defrays all the expenses of prizes at these shows, which are generally held every year in each district. These State Shows are now regulated by the Law of 8th June, 1912.

† These rules were slightly altered in later years, and more offspring are required to be shown.

yearlings. These "Offspring Shows" are also a special Danish feature.

By these means farmers had for a number of years been encouraged to preserve good bulls for service. While in 1887 only 371 bulls were presented at the District Shows, there were in 1908 more than 1,200 at the State Shows, and at some local shows as many as 250 old bulls are shown every year.*

The Law of 1902, by which time the milk recording societies had already collected many records of the milk yield of cows, offered a further grant of £750 to cattle breeding societies, "which, by showing superior offspring, have proved to be particularly capable of developing good strains of dairy cattle." Such breeding societies could compete for participation in this grant by showing, at the Offspring Shows, their bulls and one-eighth of the total number of their cows, and at least 2 bulls and 24 cows. One-fourth of the number of cows must be between one and two years' old, and for at least one-fourth of the number of cows two years' records of the yield of milk must be produced. Breeding societies have an additional claim to the grant if they show animals closely related to one another through sire or dam, that is, if they have formed or are on the way to form "tribes" or families of dairy cattle producing a high yield of butter.

When the Law was amended in 1912 the form of this grant was altered and further encouragement was offered to cattle breeding societies which had many of their cows under the control of the milk recording societies. A grant is offered for each bull belonging to a cattle breeding society when the bull is at least $1\frac{1}{2}$ years old and has been awarded certain prizes at shows, but the amount of the grant per bull varies from £4 to £5 or £6 according to whether less than half, more than half or more than three-fourths, respectively, of all the cows belonging to members of the cattle breeding society are being reliably controlled as to their yield of milk, by quantity and quality, and their consumption of fodder.

(To be concluded.)

* Mörkeberg, l.c, page 999.

PIGS FOR PORK.

SANDERS SPENCER.

DURING the past half century great improvements have been made in our farm animals, but probably no class of stock shows a greater advance than the humble pig, which has become quite popular beyond the ranks of the mere agriculturist. The change in public opinion has been marked, as within the memory of the present writer, extending, alas, over more than sixty years, the pig was deemed to be a mere necessary nuisance on the farm and was tolerated on account of its utility in converting inferior farm produce into that pork which formed a large portion of the meat diet of those connected with the land.

In the middle of last century the life of the pig was divided into three parts; the first continuing for some two months, was a fairly happy one, as the dam from whom it received the major portion of its sustenance was looked upon for that limited period as worthy of some food and attention in order that it might be enabled to perform its maternal duties successfully. This attention might in some cases have been continued for a short time after the separation of piglings and their dam, but in comparatively early life the store or growing pig had to fend for itself and to search for and even to steal the limited quantity of food which fell to its share for several months, frequently at least twelve months, or until the harvest of the year had been stored and a portion of it threshed, when in place of a spare and irregular diet the fatting pig lived for a few months in ease and idleness beside a continually well-filled trough.

In the olden times, which are still nick-named good, the fat pig of the period was usually one which had arrived at the mature age of eighteen months. It was a large pig of no particular type or form, whilst there was great variation in its colour, this last being controlled generally by the fancies of the residents in the various districts in which the fattened pig had been bred and fattened. This fancy for a fat pig of a particular colour was general and very marked, a belief existing in some parts of the country that the pork from a pig of a light colour was of far finer flavour than that furnished by a pig of a dark colour, whilst exactly the opposite opinion was as firmly held and acted upon in an adjoining district. As there existed very little difference in the form and character of the pigs common

in most parts of the country this preference for a pig of a certain colour was most probably attributable to fancy. There might have been some slight cause for the preference for a pig of a dark colour in those parts of the country where the hair of the pigs was removed by burning instead of by the more common plan of scalding, as the singed white pig did not present so pleasant an appearance to the eye and to the buyer of the meat as did a black pig which had been singed.

Until within comparatively recent years there was little difference in the class of pig and the degree of fatness between the pig killed for pork and the pig which was intended to be cured for bacon. Indeed, a very large proportion of the fat pigs were killed during the winter months and the same pig afforded both the joints of fresh pork which consisted of the loin, spare ribs, &c., and the parts intended to be salted and dried for consumption as bacon, during the following summer. There was thus little necessity for that variation in the age and degree of fatness of the slaughtered pig which exists to so great an extent at the present time, nor did there then exist that keen demand for small joints of pork from young pigs which has in recent years caused so great attention to be paid to the early maturing qualities of the smaller breeds of pigs.

The changes in the size, degree of fatness and age of the fattened pigs have originated in various ways. The introduction of railways and the consequent free movement of fat pigs from one district to adjoining or even distant ones had a great effect, whilst a still more potent influence may have been the enormous increase in the spending power of the wage-earning classes. The large joints of exceedingly fat pork and the heavily salted and thick sides of bacon from aged pigs are no longer saleable, even to those engaged in strenuous labour. The present demand is for small joints of pork and mild-cured bacon from young pigs, because these are finer in flavour and much more easily digested, and probably because a much larger quantity can be consumed without serious inconvenience.

It may also be possible that fashion was not without its influence on the change in the type of fat pig generally in demand. Some fifty or sixty years ago, when agricultural shows became common, the fashionable pig was small in size and excessively fat, the greatest offenders in these respects being the small white and the small black breeds of pigs, strongly supported by the then fashionable Berkshire pig. This craze for small and pretty pigs was speedily followed by

the equally senseless fancy for very large and very fat pigs, mainly consisting of potential lard. About forty years since the demand for a change in the quality of the pork and bacon to make them more suitable to the requirements and fancies of the consumers became so insistent that a few of the more practical breeders of improved pigs endeavoured to produce two distinct types of pigs, the one for the furnishing of fresh pork and the other more suitable for conversion into the mild-cured bacon which was becoming so exceedingly popular amongst all classes of consumers. At that period or a little earlier the improved or pedigree pigs were mainly of the so-called Yorkshire breed, which again was subdivided into large, medium and small types, the Berkshire and the Small Black. Of these the small white and the small black have disappeared owing to their unsuitability for supplying pork of the kind demanded and for conversion into bacon. Many other applicants for fame have arisen, of local origin, but greatly improved by selection and in many cases by the judicious infusion of outside blood. Until within quite recent years the opinion was prevalent that almost any breed or type of pig was suitable for the fresh pork trade or for the bacon trade, and that it was far more a question of age and degree of fatness of the slaughtered pig than of breed or type. The persistence of the consumer in buying at the highest prices only the particular class of pork and of bacon which he desired for his consumption has had a great educational influence on pig breeders, who have of late paid far more attention to the requirements and even the whims of consumers, with the result that the variations between the fat pig intended for sale as fresh pork and the one intended for bacon curing have become quite defined.

There are three distinct types, size and degree of fatness, of joints of pork in demand in the various parts of the country. These are furnished by the so-called porker and fat pork types of pigs. The type of porker most in demand in London and the south-eastern parts of the country is one of some four or five months old and weighing alive from 80 to 100 lb. The porker more commonly consumed in the South Midland counties weighs alive 140 lb. when some six months old; and the fat pork pig is more generally demanded by customers in the North Midlands and the "Black country," and weighs from 250 to 300 lb. at twelve to fifteen months old.

It will be noticed that both climate and the strenuousness of the labour performed by the wage-earning classes appear

to have had an influence in determining the demand for the particular class of meat in the different districts. In selecting the parents for breeding pigs for pork one of the chief points for consideration is the ability to mature early, so that with liberal and judicious feeding the young pig will have become fat enough in early life to furnish a carcase of pork, with a full proportion of fat to the lean meat—or as it is commonly termed a ripe carcass of pork, with a comparatively small proportion of bone and offal. Excessive length of body is not so much a consideration as it is with pigs intended for conversion into bacon, as a long pig is generally one which requires some considerable time to develop and there is not so great a variation in the value of the different portions of the fresh pork from the porker as there is in the side of bacon—in which the middle portion of the side is about one-third more valuable on the market than the two end parts. Both boar and sow should therefore possess in a marked degree quality of bone, skin, hair and flesh in addition to those other qualities which are essential to success in breeding.

Although there may be some of the smaller types of pigs common in the southern parts of the country which will produce passable porkers, it is considered to be necessary for the boar at least to possess a considerable amount of improved blood of such a type as the Middle White or Berkshire breeds. These two breeds and their crosses furnish the pigs which are well nigh perfect for the manufacture of small pork. Should the white colour in the crosses be a point to be considered, as it is in many of the chief markets, this can best be secured by mating the Middle White boar with the Berkshire sow, when nearly all the produce will be white in colour or with occasional blue spots, whereas if the reverse crossing be adopted, there will be a far greater probability of the young pigs being dark in colour. Apart from this the first-named cross is perhaps to be less recommended, as the Middle White sows are considered to be generally somewhat more prolific and better mothers than the sows of the Berkshire breed, to be of a quieter disposition and to produce somewhat more milk.

At one time it was commonly believed that a cross-bred pig from two pure-bred parents of different breeds was superior to the pure-bred produce of either of the two pure breeds, and it must be confessed that there might have been some substantial ground for this belief in the past when so much greater consideration was given to line breeding than to the equally

important utility properties such as constitution, lean flesh and milk. Of late years a change has come in the practice and consequently in the belief, so that the keeping of pure-bred Middle White pigs for the production of small pork is becoming far more general, whilst for this branch of the pork trade there are also being bred large numbers of pigs which are the produce of ordinary country sows of the small type mated with Middle White or Berkshire boars.

It is claimed that the production of small pork is by far the most profitable branch of the pig industry because the sows cost less to keep, the pork costs less per lb. to produce, and the market value of the pork is higher than that from old and heavy pigs. The alleged decreased cost in the production of pork may be due to a very considerable extent, if not wholly, to the fact that young pigs need a smaller weight of food than older pigs to make a given increase in their live weight. Experiments have shown that a gradual but sure increase in weight of food is required for each pound of addition to the weight of the live pig. Against this advantage in the production of light weight fat pigs must be set the increased number of lives which have to be sacrificed to produce a certain weight. This is not at the present time so serious a matter, now that the price of weanling pigs is approaching the normal as it was a year or two since when pigs newly weaned were selling at prices up to £4 each. Under the latter condition the raw material in the form of live pig would have cost at least four times as much as it would now. This variation would not perhaps appear to be so large if the producer of porkers adopted the more profitable system of breeding the pigs which he converted into small pork.

With regard to the increased cost of the production of pork from older than from young pigs, Professor Henry gave the combined results of numbers of experiments carried out at various agricultural stations in the United States, and from them estimated that pigs weighing alive from 15 to 50 lb. required 293 lb. of food to make an increase of 100 lb. in their live weight, pigs from 50 lb. to 100 lb. required 400 lb., pigs from 100 to 150 lb. required 437 lb., pigs from 150 to 200 lb. required 482 lb., pigs from 200 to 250 lb. required 498 lb. and pigs from 250 to 300 lb. needed 511 lb. These figures show a difference of more than two-fifths between pigs weighing 15 to 50 lb. and those weighing 250 to 300 lb., the latter being about the heaviest weight of fat pigs marketed at the present time for pork purposes.

In the production of porkers, some breeders prefer a sow of somewhat larger scale than the medium-sized white and black sows referred to above, favouring a sow of the Large Black, Gloucester Old Spots, Tamworth, Cumberland, one of the two Sheeted types or even a Large White of a compact type, which they mate with the thicker and more compact Berkshire or Middle White breeds. In thus crossing less uniformity of size is obtainable, but objection is not always taken to this as it is possible to use the compact and thick pigs for conversion into small pork, whilst the more lengthy and growing pigs are fatted for the heavy pork or the bacon trades.

This crossing of the medium sized and large sized breeds of pigs is more common in the southern and midland counties than in those northern counties where large fat pigs only are mainly slaughtered, although even in this respect a change is noticeable in one or two of the largest markets in the north, where fat pigs weighing not more than two-thirds the weight general only a comparatively few years since, command the highest price.

It would thus appear that the demand for the old-fashioned fat pig of 300 lb. is gradually but surely passing away. If this be so a change may also be brought about in the system of producing the heavy fat pig. The plan which used to be commonly followed was to use a pure bred sire of any of the large breeds of pig, the Large White, Large Black, Tamworth, Gloucester Old Spots, Southern or Eastern Sheeted, Lincolnshire, &c., on the ordinary country sows or sows of any of the pure-breeds or crosses; to rear the young pigs well and then to run them on as stores or growing pigs without any great outlay in the purchase of foods other than those produced on the farm; and then when the pigs were several months old they were put up to fatten and fed mainly, and in many instances solely, on concentrated and comparatively expensive foods. The change to improved methods which has been observable of late years will doubtless be accelerated by the still greater change in the alteration in the degree of fatness and size of the joints of pork demanded by the consumer. It is more than probable that a change in the aim of the breeders of pedigree pigs may in due course be noticeable; compactness of form, quality of skin, bone and hair, and early maturity may receive a far greater amount of attention than mere size, the last a point which has in the opinion of many purveyors of meat been studied to an extent greater than advisable or desirable.

ROOTS v. SILAGE FOR DAIRY COWS.

A. W. OLDERSHAW, B.Sc.,
Agricultural Organiser for East Suffolk,
and
F. C. SMITH, B.A.

IT is well known that in the Eastern Counties the system of ensilage has made great progress during recent years. In 1916 an experiment was conducted by one of us on the farm of Mr. C. C. Smith, Walton Hall, Felixstowe, to ascertain whether a ration of 60 lb. of silage could replace 60 lb. of mangolds and 7 lb. of straw chaff. It was found that there was very little difference in the amount of milk given by the cows fed on the two rations. Particulars of this experiment were given in this *Journal* for June, 1916. Since then it has been claimed that, owing to the fact that silage contains considerably more albuminoids than roots, it is possible to reduce the quantity of expensive concentrated food fed when silage is being used.

This argument appeared to be reasonable, and the matter was considered to be of sufficient importance to warrant the conducting of a special experiment to test the point. Mr. C. C. Smith again very kindly placed his herd of cows at Searson's Farm, Trimley, at our disposal, and the twelve most suitable cows in the herd were selected for the purposes of the experiment. Unfortunately some of the cows had calved rather a long time before the experiment commenced, and consequently their milk yield was getting somewhat low. It was decided to feed the following rations daily:—

Silage Ration.	*Root Ration.*
60 lb. Silage.	60 lb. Yellow Globe Mangolds.
2 „ Dried Grains.	4 „ Dried Grains.
2 „ Decorticated Cotton Seed Meal.	4 „ Decorticated Cotton Seed Meal.
10 „ Chaffed Straw (Barley).	10 „ Chaffed Straw.
14 „ Kale (Marrow-stem).	14 „ Kale (Marrow-stem).

All the marrow-stem kale was used up on 20th February, and from that time the rations fed were as above, without the kale. The silage fed was made from winter oats and tares, sown at the rate of 2 bushels of oats and 1 bushel of tares per acre. It was made in a cylindrical stave silo of the usual pattern. The green material was chaffed and elevated into the silo by a combined cutter and blower, the work being done on several days from 20th to 27th June, 1920.

Composition of the Rations Fed.—A sample of the silage was taken for analysis and was very kindly examined by Mr. W. S.

Mansfield, M.A., of the School of Agriculture, Cambridge, with the following results. For purposes of comparison the analysis of the silage upon which the experimental cows were fed in 1916 is also given.

Oat and Tare Silage on which experimental Cows were fed.

	1921 *sample.*	1916 *sample.**
Water	73.55	72.30
Ether Extract	1.37	1.14
Albuminoids	3.10	4.96
Carbohydrates	12.09	9.75
Fibre	8.40	9.43
Ash	1.49	2.42
	100.00	100.00
Sand and Silicates	.27	

It is worthy of note that the 1916 sample contains considerably more albuminoids than the 1921 sample. The 1916 sample was made from oats and tares sown at the rate of 1 bushel of oats and 2 bushels of tares per acre, while the 1921 sample was made from the produce of a mixture of 2 bushels of oats and 1 bushel of tares. The larger proportion of the leguminous plant (tares) in the 1916 sample may account for the larger proportion of albuminoids present.

Mr. Clement Smith's herd of cows at Searson's Farm is recorded by the Suffolk Milk Recording Society, and the milk of the cows under experiment was weighed daily under their auspices, the milk recording sheets issued by the Ministry of Agriculture being used for this purpose. In the Ministry's milk recording scheme, when daily records are kept, the record sheet commences at Sunday afternoon's milking and continues until and includes the next Sunday morning's milking. The week ending 30th January, therefore, includes the afternoon milking of 23rd January and the morning milking of 30th January. For the sake of simplicity it was decided to utilise this plan in the experiment.

In order to give the cows an opportunity of becoming accustomed to their diet they were fed on their respective rations for a preliminary week, *i.e.*, the week ending 23rd January. The records in this preliminary week were not taken into account. The plan was adopted of changing over the rations, *i.e.*, feeding one lot of cows for four weeks with silage, after which they received roots, whilst the cows which received roots during the first four weeks of the experiment

* Analysed by Mr. G. S. Robertson, M.Sc., East Anglian Institute of Agriculture, Chelmsford.

received silage in the last four weeks. In this way it was hoped as far as possible to eliminate differences due to the individuality of the cows. After they had been under experiment for four weeks, when the first part of the experiment was over, an intervening week was allowed (ending 27th February) to enable the cows getting silage to become accustomed to the root diet and *vice versa*. The records of this intervening week were not taken into account. In the preliminary week ending 23rd January, the cows getting root had 14 lb. of chaffed straw and the cows getting silage 7 lb., but it was found that the root lot were not eating up their chaff, so it was decided to feed both lots with 10 lb. of chaff during the whole experimental period. It was found that both lots of cows ate up their food well. The total quantity of concentrated food fed to the six silage cows was 4 lb. x 6 = 24 lb. This food, however, was not equally distributed, the cows giving more milk receiving rather more of both concentrated and coarse food, whilst those giving less milk received less food. The average daily ration of silage and root cows, however, was that given previously, the foods being measured and weighed daily in bulk for each lot. It was considered that this method was the best, in view of the varying milking capacity of the cows.

The composition (crude) of silage taken is that of the actual sample analysed by Mr. Mansfield.

Table showing composition of the Rations fed.

Total ingredients present in pounds.

Silage Ration.	Dry matter.	Protein (albuminoids).	Oil.	Carbohydrates. Soluble.	Carbohydrates. Fibre.	Ash.	Digestible Crude Protein.
60 lb. Silage	15·87	1·86	·82	7·25	5·04	·89	1·68
2 lb. Dried Grains ...	1·79	·37	·13	·92	·30	08	·26
2 lb. Cotton Seed Meal (Decorticated) ...	1 83	·84	·22	·50	·15	·12	·73
10 lb. Barley Straw Chaff...	8·6	·33	·18	4 24	3·39	·46	·08
14 lb. Kale	2·07	·35	·04	1·22	·24	·22	·25
Total	30·16	3·75	1·39	14·13	9·12	1·77	3·00
Root Ration.							
60 lb. of Yellow Globe White-fleshed Mangolds	6·42	·60	·06	5·64	·42	·42	·42
4 lb. Dried Grains ...	3·59	·73	·26	1·84	·60	·16	·52
4 lb. Cotton Seed Meal (Decorticated) ...	3·66	1·68	·14	1·00	·30	·24	1·46
10 lb. Barley Straw Chaff...	8·60	·33	·18	4·24	3·39	·46	·08
14 lb. Kale	2·07	·35	·04	1·22	·24	·22	·25
Total	24 34	3·69	·98	13 94	4·95	1·50	2·73

Taking the composition of foods given in *Rations for Live Stock*, by Professor T. B. Wood, F.R.S. (Miscellaneous Publications, No. 32, published by the Ministry), the following table shows the composition of the rations fed during the first month of the experimental period until 20th February.

Quality of the Milk.—It is worthy of note that no offensive odour or other abnormality was noted in any of the milk produced during the whole period of the experiment.

The milk was not tested for fat content, as it was considered unnecessary to do so.

It used to be held that the feeding had a considerable influence upon the richness of milk, but more accurate investigations go to show that it has very little to do with it. The subject was discussed by Dr. Crowther in a previous issue of this *Journal*. He found that, provided the ration is sufficient to maintain the milk yield and general "condition" of the animal, the composition of the milk can, in general, be but little affected by changes in the nature of the foods. Even in the case of under-feeding the composition of the milk is, as a rule, but little affected until the condition of the animal has been very seriously reduced. The common view that turnips or brewer's grains give watery milk has received but little support from experimental investigations, although the long-continued use of these foods may lead ultimately to a general weakening of the organs of the body, and result in poorer milk. Ability to yield rich milk is inherent in the cow, and if more butter fat is to be got from any cow, it can only be done by feeding to get a greater yield of milk of the same quality.

Taking the figures for the two lots, we get the following:—

Silage (with chaff and 4 lb. daily of concentrated foods).

			Yield of Milk in lb.
6 cows of Lot I. fed on Silage	1st 4 weeks 23rd Jan. to 20th Feb.	(p.m.) (a.m.)	3,366¼
6 cows of Lot II. ,,	Last 4 weeks 27th Feb. to 27th March	(p.m.) (a.m.)	2,634¼
	Total	...	6,000½

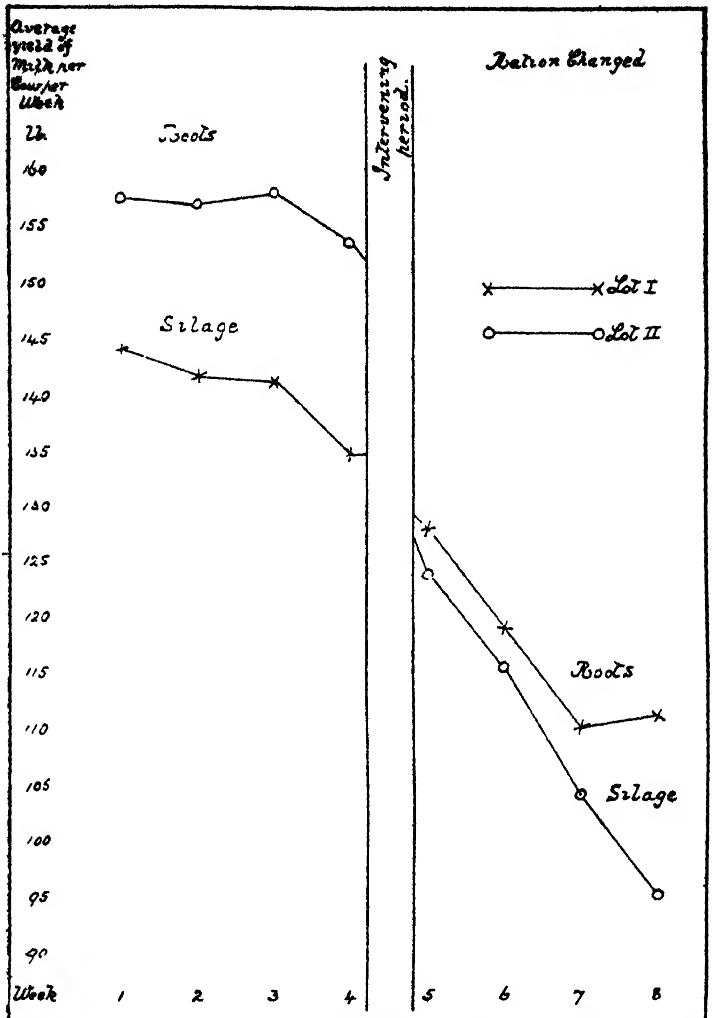
Roots (with chaff and 8 lb. daily of concentrated foods).

6 cows of Lot II.	1st 4 weeks 23rd Jan. to 20th Feb.	(p.m.) (a.m.)	3,754¾
6 cows of Lot I.	Last 4 weeks 27th Feb. to 27th March	(p m.) (a.m.)	2,807½
	Total	...	6,562¼

Table giving weekly Milk Yield of Cows in pounds. 1921.

Ear Mark of Cow.	Date of Calving.	Week ending Jan. 30th a.m.	Week ending Feb. 6th.	Week ending Feb. 13th.	Week ending Feb. 20th.	Week ending Mar. 6th.	Week ending Mar. 13th.	Week ending Mar. 20th.	Week ending Mar. 27th.	Total yield during experimental period.
					Lot I.					
		Silage, &c.				*Roots, &c.*				
K 2134	Oct. 7th	213	207¼	220	206	176¼	174½	163	159	1,519¼
K 2231	July 1st	151¼	141	133½	125	99½	67½	39	34	790¾
K 3410	Sept. 18th	120¼	117	115¼	110¾	110½	110	112	112	908
*K 3988	June 19th	117	117	111½	108½	111	106¾	103¼	121½	896½
*K 3993	July 4th	142	141¼	141¼	138	149	145¼	141	143½	1,114½
*K 3990	July 2th	119½	125½	125½	119¼	122	109	103	94½	917½
TOTALS	... ...	863¼	848¼	847	807¾	768¼	713	661¼	664¼	6,173¾
					Lot II.					
		Roots, &c.				*Silage, &c.*				
K 2132	June 1st	169½	166	170½	156	118¾	104½	84½	67	1,036¾
K 2133	Aug. 27th	203	207¼	202½	204½	172	166	150½	143½	1,449¼
K 2131	Sept. 14th	181½	181	186	186½	160½	154½	141¼	135	1,328½
*K 3994	July 14th	122	112¼	104½	98	55½	44¼	34	25	595¾
*K 3991	Aug. 11th	130½	135½	141	136½	114	103½	95¼	89½	945¾
*K 3996	Aug. 6th	138	141	140	139	120½	120½	118¼	115½	1,033
TOTALS	... ...	944½	943¼	946½	920½	741¼	693¼	624¾	575½	6,389

* Heifers.


Average yield of Milk per Cow per Week
lb.
160
155
150
145
140
135
130
125
120
115
110
105
100
95
90
Week
1
2
3
4
5
6
7
8
Roots
Silage
Intervening period.
Ration Changed
Lot I
Lot II
Roots
Silage

F. I

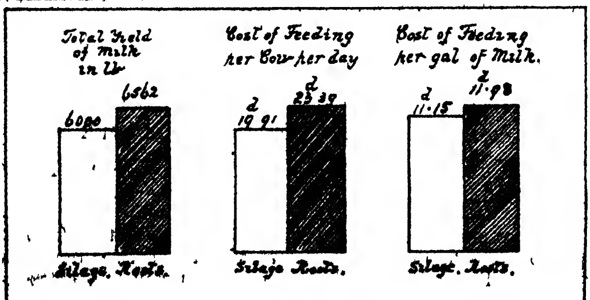

Total Yield of Milk in lb.
6090
6562
Silage. Roots.
Cost of Feeding per Cow per day
d
19.91
d
23.39
Silage Roots.
Cost of Feeding per gal of Milk.
d
11.15
d
11.98
Silage. Roots.

Fig II

It is evident from these figures that the cows fed on 60 lb. of roots with 8 lb. of concentrated foods daily, other foods being identical, gave 562 lb. (*i.e.*, about 56 gallons) more milk than the cows getting 60 lb. of silage and 4 lb. only of concentrated foods. This is probably a real difference and outside any possible experimental error. As the experimental period was 56 days, it follows that the difference in favour of the root-fed cows was ⅛th of a gallon daily per head.

Taking into consideration the cost of the two rations fed, we get the following:—

Silage Ration.		*Estimated or (in case of purchased foods) actual cost per ton.* £ s. d.	*Cost of Quantity fed in ration.* d.
60 lb.	Silage	1 7 0*	8.70
2 „	Dried Grains	10 0 0	2.12
2 „	Decorticated Cotton Seed Meal ...	17 0 0	3.64
10 „	Chaffed Barley Straw...	3 0 0	3.21
14 „	Kale	1 10 0	2.24
	Total estimated cost of food daily per cow		19.91

Roots Ration.		*Estimated or (in case of purchased foods) actual cost per ton.* £ s. d.	*Cost of Quantity fed in ration.* d.
60 lb.	Yellow Globe Mangold	1 0 0*	6.42
4 „	Dried Grains	10 0 0	4.24
4 „	Decorticated Cotton Seed Meal ...	17 0 0	7.28
10 „	Chaffed Barley Straw	3 0 0	3.21
14 „	Kale	1 10 0	2.24
	Total estimated cost of food daily per cow		23.39

The total cost of the food of 6 cows for 8 weeks on the silage ration would thus be $6 \times 8 \times 7 \times 19.91$d. = £27 17s. 5d., while that of the 6 cows for 8 weeks on the root ration was $6 \times 8 \times 7 \times 23.39$d. = £32 14s. 11d.

In the case of *the silage ration*, 600 gallons of milk were produced, so that the cost of food only per gallon of milk (excluding all other items such as labour, depreciation in value of cows, &c.), works out at 11.15d. per gallon.

The roots ration produced 656 gallons of milk, and the cost for food only works out at 11.98d., *i.e.*, almost 1s. per gallon of milk produced.

* The cost of production is dealt with in an article in this *Journal* for July, 1916, p. 333. The figure then arrived at, viz., 13s. 6d. per ton for silage, has been doubled. Similarly, the pre-war cost of production of mangolds has been taken at 10s. per ton and the figure doubled.

This experiment does not take into account the somewhat greater cost of labour in feeding roots than in feeding silage. On the other hand, it also does not take into account the fact that if the cows give less milk, more cows are necessary to produce the same quantity of milk, and this involves more labour and more capital invested in the cows, buildings, &c., with a correspondingly greater depreciation in value of the larger number of cows necessary.

Conclusions.—From the results of the experiment it would appear that 60 lb. of oat and tare silage, fed with barley straw, kale and 4 lb. of mixed concentrated foods (equal weights of decorticated cotton cake and dried grains) gave about one-sixth of a gallon of milk per cow daily less than 60 lb. of mangolds fed with the same quantity of barley straw and kale but double the concentrated foods. That is, 60 lb. of silage was not equal in milk-producing capacity to 60 lb. of mangolds and 4 lb. of concentrated foods.

The cost of the silage ration, in the production of milk, however, was $\frac{3}{4}$d. per gallon less than that of the root ration.

HOME CURING OF BACON.

Mrs C. E. Curtoys.

It is a cause for general satisfaction that there has been a revival in the country districts of the home curing of bacon, especially during the past year. For a variety of reasons this thrifty and sensible practice had largely been given up. The importation of large quantities of foreign bacon for many years past had so reduced the price of the home produced article that country folk had begun to get indifferent about curing their own, and seemed to find it easier to run to the village shop for what they required. Then came the War, prices rose, and bacon realised unheard-of prices. We are still paying very large sums to foreign countries for bacon when every shilling is needed at home, and the imported bacon cannot compare in quality and flavour with our own home-cured.

There is no important reason why most country folk should not keep their own pigs and kill and cure their own bacon. The trouble is small, and is more than compensated for by the valuable return; the keeping of pigs is useful as well as profitable; all waste vegetables and chat potatoes can be boiled up and used for feeding the pigs; and the pigs in their turn will provide valuable manure for garden or allotment. The bacon pig does not require to be forced or richly fed, but should be fed steadily and regularly and not be over-fat. A plump pig of 10 to 12 score will make the best bacon, and a good bacon pig of about this weight should be ready at 8 or 9 months old. An eight weeks' old pig bought about May and fed through the summer should be ready about the following November.

Bacon can be cured in two or three different ways, all simple and easy, and involving no expensive paraphernalia. It can be (1) dry salted, (2) brine cured, or there may be (3) a combination of both. Some of the best bacon is cured by the last method, which has the further merit of effecting the curing most rapidly. The methods of curing commonly vary with the locality, but all three methods may be found in one locality. There are also different methods of cutting up the pig for bacon.

In the north, where pigs are weighed by the stone (14 lb.) and are mostly Large Whites, they are sometimes allowed to grow to a great size, and it is common to have a bacon pig weighing 40 stone. The usual weight, however, is 25 to 35 stone, and 25 stone is the best weight; beyond that the proportion of fat to lean becomes excessive and wasteful, and has a tendency

to turn rusty, yellow and rank when cured. On cutting up the pig it is the custom to cut a thick piece about four inches wide out of the centre of the back, right down from neck to tail. This is called the chine, and is cut up into four pieces, the neck chine being the largest. It is also the custom to take the hams off and cure them separately, as the hams of such large pigs would weigh from 30 to 40 lb. each.

In the south and south midlands the piece down the back is as meagre as possible, being the bare amount necessary to remove the backbone, and it is called the "Lazarus," presumably because it is so poor.

There are two ways of dealing with the flitches—(1) Country cut, (2) London cut. In the country cut the sweetbone, griskin and sparerib are removed and used or sold separately as joints. This is considered more profitable if selling the bacon, but for home consumption the curer will do well to use the "London cut," in which no meat at all is removed. The "sparerib," however, is nearly always taken out, except in a very small pig.

In Lincolnshire, where home curing of bacon is the rule, the "putting away" of the pig is one of the most important days of the year to the housewife. Every part of the pig is turned to account, and a wealth of pork pies and sausages as well as superior quality lard, is produced by the end of the day. There is a veritable feast for the labourer and his family for some days after the killing of the pig, and some of the excellent pies and sausages may be sold to neighbours. In the midlands and south not so much of this is done, the custom being to sell the spare meat as fresh joints instead of converting it into sausages and pork pies, the meat being somewhat differently cut out.

Killing the Pig.—This will usually be done by the butcher and cutting up should take place the next day. In some cases killing takes place on Saturday and cutting up on the following Monday. It is important to allow the meat to set. In very cold weather it is possible to kill and cut up the same day, and get the bacon in salt, but it is best to kill at least a day before. The butcher will kill and hang up the pig, and return the next day to cut it up, the housewife in the meantime preparing the materials for curing. The butcher should remove the knuckle bone from the hams and "draw" the shoulder blade to allow the salt to work into the meat.

Curing.—For *dry salting* the sides of pork should be placed on a low wooden bench the length of the pig, the bench being first sprinkled with a good layer of salt. If a bench is not available

boards placed on bricks will answer the purpose, and the writer has known bacon to be very well cured by simply laying it on a clean stone floor. With a moderate sized pig of 9 to 10 score the hams need not be cut out, but cured with the sides, using about 1 stone of coarse salt (about 2 bars), 1 lb. of saltpetre, and 1 lb. of coarse brown sugar. Some of the saltpetre should be well rubbed into the meat by hand, and especially into the rind, side and edges of the meat. The salt should then be rubbed well in, the remainder of the saltpetre and sugar should be mixed with salt and a fairly thick layer be placed on the bacon, the sugar especially on the thick part of the hams. The hand should be pushed into the shoulders and the hams where the bones have been removed and this mixture well rubbed in. Next day moisture should be drained off, the sides must be turned every two days, and a little more salt put over and under. The whole may be left in salt for a fortnight to three weeks according to the size of the pig. The head is split and salted for two or three days and will make an excellent brawn boiled with 1½ lb. of lean beef and pressed. When the bacon is taken out of salt, it should be well scrubbed on the rind side and washed all over to remove surface salt, carefully wiped as dry as possible and hung up in a cool, airy place to dry. The washing prevents rust and the bacon will dry off clean. When dry the hams can be cut off, and to keep from flies they should be sewn up in unbleached calico and hung up in cool dry place, together with the flitches.

Brine-curing.—1 stone of salt, ½ lb. of saltpetre and about 10 gallons of cold water will brine-cure one pig of about 10 score. The sides should be left in the brine for a fortnight to three weeks, or removed from the brine in a week, wiped dry and dry-salted for one week, a fortnight in all. A wooden tub or a tank would be used for the brine and should be long and wide enough to take the sides of bacon flat. This last method is more satisfactory than complete curing by means of brine. In dry salting the sides may be placed one on the other, but their position should be changed daily; as in all other things it is the care and personal attention that is most important in curing bacon and hams.

Hams can be pickled, if preferred to ordinary curing. A very good Wiltshire recipe is as follows:—Sprinkle the ham with salt after it has hung two or three days and let it drain. Make a pickle with 1 quart of strong beer, ½ lb. of treacle, ½ lb. of coarse sugar, 1 oz. of coriander seed. 2 oz. of juniper berries, 1 oz. of pepper, 1 oz. of allspice, 1 oz. of saltpetre, ½ oz. of salt prunelle, a good handful of common salt: pound together, warm and pour over the ham; rub and turn every day for a

fortnight. Clean and dry off, and sew up in a thin calico bag.

A Wiltshire recipe for bacon for a pig of 8 score:—Sprinkle the flitches with salt and let drain 24 hours; then mix 1½ lb. of coarse sugar, 1½ lb. of bay salt, 6 oz. of saltpetre and 4 lb. of common salt; rub the mixture well into the bacon, turning and rubbing every part daily for a month; dry off and smoke 10 days.

A Berkshire recipe for curing a ham of about 16 lb.:—½ lb. of coarse moist sugar, ½ lb. of common salt, 1 oz. of saltpetre, 1 oz. of bay salt, 1 oz. of ground black pepper. Dissolve over a slow fire and put the paste on the fleshy part of the ham as warm as the hand can bear it. When the paste is dissolved baste twice daily for a month, wipe well and dry off.

Curing a bacon pig of 14 score:—1 lb. of saltpetre, 1½ lb. of coarse brown sugar, 1½ lb. of salt; first day sprinkle with saltpetre, then mix remainder with sugar and salt; rub in well, finish with a good layer of salt; leave about three weeks, and during the last two days rub with a little pepper.

The Lard.—For lard which has to be rendered down for use, the leaf fat will have been carefully removed, also the apron fat and trimmings. The leaf fat is the finest and best and is rendered down separately. It is cut up into small pieces of about an inch and the fat boiled out, then it is passed through a fine strainer and poured into the bladder, which should have been thoroughly cleaned. This is done by turning the bladder inside out, scrubbing it well and soaking in salt water, subsequently drying. The apron fat and trimmings are also cut up, boiled down, and strained into jars or basins. Eaten with bread the scrap fat that remains after straining makes a pleasant and wholesome food for children, and is very popular with the young people. It is known as "crumps" in some parts. The leaf lard in a well-fed pig should weigh in lb. the weight of the pig in stones. Thus, for a 25 stone pig there should be about 25 lb. of leaf lard. If well boiled it will keep for a year.

The meat trimmings can be turned into pork pies and sausages and will make a pleasant change for breakfast fare. The whiter pieces are used for sausages and the darker for pies.

In Lincolnshire, parts of the pig are used in the Christmas mincemeat and it must not be forgotten that the fry, consisting of the liver, sweetbread and pluck, makes a variety of savoury dishes which are a welcome relief to the monotony of the poor man's daily fare. It will be readily seen that a pig is a mine of wealth to the poor man, who should be encouraged by every means to keep pigs of his own.

ROYAL COMMISSION ON IMPORTATION OF STORE CATTLE.

THE Royal Commission on the Importation of Store Cattle, appointed on 11th May, 1921, issued its report in the middle of September. The Commission was appointed to inquire into the admission into the United Kingdom of live stock for purposes other than immediate slaughter at the ports; whether such admission would increase and cheapen the meat supply of the country, and, if so, to what extent; and whether such admission is advisable, having regard to the necessity of protecting live stock bred in the country from the introduction of disease and of restoring their numbers after the losses to which they have been subjected during or since the War.

The Commissioners for the purpose of the inquiry were:—Viscount Finlay, Lord Askwith, Sir A. F. Firth, Bart., Sir A. E. Shipley and Sir W. H. Peat, with Mr. A. W. Cockburn as Secretary.

The conclusions at which the Commissioners have arrived are as follows:—

(1) We are of opinion that the admission into the United Kingdom of Canadian cattle for purposes other than immediate slaughter at the ports, would tend to increase the meat supply of the country to some extent, but it must not be assumed that the increase in the meat supply would necessarily be equivalent to the whole number of cattle so admitted, as it is possible that some of them might merely replace stores raised in Great Britain or Ireland.

(2) We think that such admission would tend to cheapen, in some measure, the meat supply of the country, but there are no data on which the extent can be accurately gauged. We think, in the long run, the tendency would be to bring prices to a level somewhat, but not greatly, lower than that which would prevail if the embargo were maintained.

(3) We think that the importation of Canadian stores would tend to satisfy in some measure the increasing demand for fresh home-fed meat.

(4) We are of opinion that such admission is advisable, as providing another source for supply of stores for the purpose of scientific agriculture, with a consequent increase of the food supply.

(5) We are of opinion that there is no substantial ground for the apprehension that such admission would introduce disease among the cattle in this country.

(6) We are of opinion that such admission would not interfere with, but would tend to promote the restoration, and, indeed, the increase of the numbers of live stock in this country after any losses sustained during or since the War.

(7) We are of opinion that the introduction of Canadian cattle would not have any prejudicial effect upon the milk supply of this country, but would, on the contrary, tend to its advantage.

(8) We find that there is a general feeling among English farmers against the admission of Canadian stores. So far as this is created by the apprehension that disease may be thereby introduced, we consider it unfounded. So far as it is based on the view that the prohibition should be kept up for the protection of the home breeding industry against competition, we do not think that the question of such a policy falls under the terms of our reference. As we have pointed out, the cost of transport to England in itself forms a considerable measure of protection to the home breeder.

(9) We are of opinion that the admission of Canadian stores might make it difficult for crofters and small farmers in the Highlands to carry on their farming operations successfully owing to competition with them in the market for the sale of stores.

(10) We are of opinion that the admission of Canadian stores might to some extent deprive the Irish farmers of the market which they at present enjoy in Great Britain for their stores.

(11) We have not thought it within the terms of reference to enter into questions of Imperial policy, as regards the food supply of the country in time of war, protection of home industries, or the effect of possible political changes in the Constitution of the United Kingdom.

INSECTICIDES AND FUNGICIDES.

HORTICULTURISTS are probably aware that, at the request of the Chamber of Horticulture and an important section of insecticide and fungicide manufacturers, a Bill has been drafted for the regulation of the trade in certain of the chemicals most generally in use for the control of pests, and especially for ensuring that the grower should have at his disposal fungicides and insecticides of guaranteed composition. In view of the Cabinet instructions on national economy it has proved necessary to postpone the introduction of this Bill to Parliament, but it is believed that many manufacturers are prepared to meet the terms of the Bill without previous legislation, and it has therefore been decided to publish certain of the more important provisions both for the information of the public in general and the manufacturers in particular. Purchasers of insecticides and fungicides of kinds mentioned below are earnestly advised to stipulate before taking delivery that the articles supplied should comply with the conditons laid down.

These conditions and the articles to which they apply are as follows:—

1. **Lead Arsenate Paste.**—(*a*) The total amount of arsenic in lead arsenate paste as sold for agricultural and horticultural purposes shall not be less than 14 per cent. of the paste in the condition in which it is sold, nor less than 28 per cent. of the pasté when dried at 100° C., the arsenic being expressed in terms of arsenic oxide (As_2O_5).

(*b*) The amount of water-soluble arsenic in the paste as sold shall not exceed 0.5 per cent., expressed as arsenic oxide (As_2O_5).

(*c*) The actual percentage of arsenic in terms of arsenic oxide (As_2O_5) in the paste as sold shall be stated on the label together with the dilution required to produce a standard spraying mixture containing 0.1 per cent. of arsenic oxide (As_2O_5).

(*d*) The amount of substance other than arsenate of lead and water in the paste as sold shall not exceed 3 per cent.

Note.—So far as the purchaser is concerned the most important provisions are those under *b*, *c*, and *d*, above, and he should realise the reasons for them. As regards *b*, arsenic in a water-soluble form is very likely to cause injury to foliage, and its presence in lead arsenate spraying compounds has at times resulted in serious losses. It is therefore necessary to prescribe that the water-soluble arsenic contained in a paste should not exceed a certain percentage which has been shown to be harmless.

Regarding *c*, lead arsenate paste consists primarily of mixtures of lead arsenates and water, some containing more water, others less. It is evident, therefore, that if all makes of lead arsenic are diluted to the same extent the resulting spray fluids may be either too weak or unnecessarily strong. The purchaser clearly should know the "strength" of the paste he is buying, and to this end it is laid down that the label on the container should state the percentage of arsenic which the paste contains, and as this must be stated in chemical terms which may not be clear to all, it must also be stated what dilution is required to make up a standard spraying mixture containing 0·1 per cent. of arsenic oxide. Such a mixture may be regarded as effective under all conditions, although for use against young caterpillars it may be unnecessarily strong. There is no difficulty, however, in diluting it to make a $\frac{3}{4}$ standard mixture. Thus in the case of a paste containing 20 per cent. of arsenic oxide, the standard mixture consists of 1 lb. of paste to 20 gallons of water, but $\frac{3}{4}$ lb. to 20 gallons may be used early in the season against small caterpillars.

In any case a standard mixture may be obtained by adding 1 lb. of paste to a number of gallons of water equal to the percentage of arsenic oxide—1 lb. to 20 gallons, with a paste containing 20 per cent., 1 lb. to 15 gallons with a paste containing 15 per cent., and so on.

In the case of *d*, when lead arsenate paste is purchased, the article should obviously not consist of some other arsenate, as for instance calcium arsenate. It is therefore laid down that apart from water, the total impurities in the paste should not exceed 3 per cent.

2. **Lime-Sulphur (Solution of Sulphides of Calcium).**—(*a*) Lime-sulphur solution as sold for agricultural and horticultural purposes shall be made from lime, sulphur, and water only.

(*b*) The specific gravity of the solution as sold shall not be less than 1.3 at 15° C.

(*c*) The solution shall be free from suspended matter and shall remain clear at all dilutions.

Note.—Lime-sulphur from the chemical standpoint is exceedingly complex, but it is clear that the purchaser should obtain only lime (calcium) and sulphur in the solution (requirement *a*). He should also know that he is getting an article sufficiently strong to make an effective spray fluid at the dilutions usually advised (requirement *b*). Finally, since the active chemicals in the solution are all soluble he should not be sold a proportion of inactive "sediment" or "sludge" (requirement *c*).

3. **Nicotine.**—It is proposed to deal under the Bill with nicotine when sold as such, but the exact requirements are still under discussion. Purchasers of nicotine should, however, note that while the term nicotine is properly applied to *the chemical in its free or uncombined state*, it is sometimes used by sellers for combinations of nicotine with an acid—*e.g.*, nicotine sulphate. Nicotine sulphate is an excellent insecticide, but it depends for its action on the nicotine it yields,

and this nicotine must be released by mixing it with an alkali or spraying soap (which is sufficiently alkaline). Further, a nicotine sulphate spraying solution can only be valued by the percentage of free nicotine it yields and not by the percentage of nicotine sulphate. It is therefore important to purchasers of nicotine that they should have a statement from the seller as to (1) whether the article is free nicotine or nicotine in combination, such as nicotine sulphate, and (2) the percentage of free nicotine in the article, or if the latter contains nicotine in combination, the percentage of free nicotine which will be produced on treatment with an alkali.

4. **Copper Sulphate.**—Copper sulphate sold for use in a spraying mixture shall contain not less than 98 per cent. of crystallised sulphate of copper ($CuSO_4 . 5H_2O$).

Note.—No comment is needed on this requirement, as it is obvious that if a purchaser needs copper sulphate for making a fungicide, he requires it free from impurities such as "green vitriol."

5. **Soft (Potash) Soaps.**—(*a*) Not less than 95 per cent. of the total alkali present in soft—that is, potash—soap sold for spraying purposes shall consist of potash.

(*b*) Soft, or potash, soap sold for spraying purposes shall bear a label giving separate percentages of (1) the fatty acids, and (2) the resinous acids, which the soap contains.

Note.—Soaps used for spraying are almost always "soft soaps," and typically such soaps are made by the combination of potash with a fatty acid. Some "soft" soaps may, however, contain considerable proportions of less valuable forms of soap—as, for instance, that produced by the union of soda with a resin acid. Potash being more expensive than soda, there is always a tendency in the cheaper soft soaps to introduce soda-resin soaps, which have the disadvantage of producing a most objectionable curd with water which is at all hard, blocking the spraying tackle and reducing the efficacy of the spray fluid. It is therefore essential that growers should be able to purchase potash (soft) soap with the guarantee that it is really made with potash, and the knowledge that fatty acids have not been replaced by resin acids.

6. **Liver of Sulphur.***—(*a*) An article sold as "liver of sulphur" shall consist of a mixture of salts of potassium, chiefly sulphides.

(*b*) It shall conform to the characters and tests given in the

* The Ministry is anxious that this recommendation should not in any way discourage the use of the sulphides of sodium. Since the action of either potassium or sodium sulphide depends on the sulphur and not on the potassium or sodium, it is undesirable to discriminate in any way against the sodium compound. When the time should come for proceeding with the proposed legislation this point will require further consideration in conjunction with the industries concerned: in the meantime it is desired to present the recommendations as nearly as possible in the form in which they were agreed.

British Pharmacopœa 1914 for sulphurated potash; and shall contain not less than 42 per cent. nor more than 45 per cent. of sulphur as determined by the process prescribed in the British Pharmacopœa for the estimation of sulphur in sulphurated potash.

Note.—Liver of sulphur is now used less often than formerly, but nevertheless those who do purchase it should obtain the potassium salts as defined above and not the cheaper sodium compounds. This remark does not imply any comparison between the values of the potassium and other sulphides for spraying purposes, but is merely to point out that if a purchaser is paying for an article, he should be supplied with it and not with something else, which perhaps costs less to manufacture.

7. **Sodium and Potassium Cyanides.**—(*a*) An article sold as sodium cyanide for agricultural and horticultural purposes shall be capable of evolving (when treated with an acid) not less than 56 per cent. of its weight as hydrocyanic acid.

(*b*) An article sold as potassium cyanide for agricultural and horticultural purposes shall be capable of evolving (when treated with an acid) not less than 43.7 per cent. of its weight as hydrocyanic acid.

Note.—In fumigating with hydrocyanic acid gas it is of the utmost importance that the dose shall be accurately calculated, and this of course is impossible unless the purchaser can obtain the "cyanide" practically pure. Purchasers should therefore insist on a guarantee in accordance with the above requirement. Sodium cyanide is almost invariably used, as it is cheaper and weight for weight gives off more gas than the potassium cyanide. The latter is included, however, in case any should still prefer it.

8. **Formaldehyde.**—This substance is not at present within the scope of the proposed legislation, but it is desirable that it should receive mention here on account of its increasing popularity as a dressing for cereals against bunt, &c. Formaldehyde is often referred to as "formalin," which was originally the trade name applied by a German company to a 40 per cent. solution of formaldehyde. It is important now that under whatever name formaldehyde is bought a guarantee should be obtained as to the percentage of formaldehyde in the solution supplied.

DORSETSHIRE ARTS AND CRAFTS, 1921.

MISS M. B. MANSEL.

A GENERAL survey of the year's work done in connection with the Dorset Arts and Crafts Association is full of encouragement. Classes have sent their work to various exhibitions. Keenness is everywhere apparent, and in spite of the fact that the annual county exhibition was held during the coal strike, which paralysed transport, exhibits and visitors were above the average in number. The high standard of work required by the judges in no way discouraged the efforts of individuals or class work. What we earnestly endeavoured to inspire in workers in all handicrafts is the desire to achieve the *highest*, both in design and execution, bearing in mind that the work sent is primarily for *exhibition* and that sales must be subordinate to the first principle. Sales are welcome and necessary: without them it would be impossible to " carry on " and repay the initial outlay, the cost of all kinds of material being still very high. Reputation for good work should ensure a good sale.

The Dorset Arts and Crafts Association has been in existence for 15 years and has held an exhibition each successive year, which has proved exceedingly valuable in setting up a high standard of work. Medals and certificates of merit are much sought after, and only awarded by the professional and expert judges when they reach the necessary standard. Criticism is sometimes very drastic, but at the same time all possible encouragement is given: both inspire further efforts to produce a better class of really artistic and practical articles.

The exhibition is useful, not only in stimulating and developing class work, but also in assisting individuals—blind, disabled and others—by advertising, selling their goods, and procuring orders for them. Letters have been received testifying to the real help the Association has been in bringing the products of the workers before the public, both by means of the exhibition and by privately advertising and pushing their wares. It is very much to be hoped that the Association has a long career of usefulness and prosperity before it.

Development.—Mr. Berens, who instituted the Studland and Swanage Arts and Crafts class, which includes leather work, metal work, needlework, wood and stone carving, painted and gilt wood, emphasises to his pupils the principle of originality in

design, demonstrating and pointing out when designs are faulty, and not permitting them to be carried into effect until perfected. They make their goods—as far as possible—from start to finish, procuring the raw material, hides, &c., and going through the different processes until the finished article is produced, thereby instilling the pride of creation and achievement, as in the old days, before a manufactured article was dissected and allocated to different departments, so becoming a co-operative production. The Studland class has to work hard to keep pace with the orders which pour in from the home country and abroad, including America, China, Australia and New Zealand. Mr. Berens feels that nothing equals exhibitions for fruitful advertisement.

The Dorset Rush Industry at Blandford is very prosperous; many of the workers are now receiving weekly pay and a bonus on sales, which in the last year amounted to £159 6s. Orders could be accepted for mats in any number, kneelers, dog baskets, wind screens, &c. This industry has been taught in several Women's Institutes; much good and artistic work is turned out from them, finding a ready sale in our Dorset Arts and Crafts and other exhibitions. Permanent dyes for rush work, similar to those used in the bright and attractive mats made in Holland, are very much needed.

One of our oldest classes led to the establishment of the sunbonnet industry of Bloxworth. In this small village, an immense variety of sunbonnets is produced by the workers, in patterns and shapes of every nationality. They travel far, parcels being sent to India, America, Australia, South Africa, and Sweden. This industry has brought much pleasure and profit to those engaged in it; during the last year the not inconsiderable sum of £145 was taken in private sales and at exhibitions, the former mostly being the outcome of the latter.

Home-made dolls and toys—mostly of the soft variety—are made in some of the Village Institutes. These find a ready sale. Novelties in this line and a greater variety would be welcomed.

There is further always a large quantity of basket and really good raffia work done in Dorsetshire.

The Annual Exhibition.—Our annual exhibition included about 3,000 exhibits, and the judges had a very busy time. The general standard was said to have improved greatly since last year, especially in the case of ornamental needlework, while the lace (both Filet and Honiton) was far above the average. Needlework done by children in various elementary schools was much commended.

Amateur glove making is very popular and was really excellent of its kind. The sum of £87 was taken at the glove section; most of the gloves being contributed by members of the Women's Institutes.

There was an increase in both light and heavy metal work. We are justly proud of the fact that the highest award given in the recent Home Arts Exhibition, held in the Albert Hall, was gained by a Dorset man, a smith of Milton Abbas. for beautiful wrought iron work. This exhibitor, whose work is becoming well known and should command valuable orders, also gained a medal at the Dorset Exhibition. He is an artist as well as a craftsman, both in design and execution, and his gates and other decorative iron work have attracted much notice.

One of the most interesting and instructive exhibits was to be found in the section for "Raw Materials and their Uses." A variety of home-dye materials, prepared from local plants and lichens, showed from what portion of the plants the shades were obtained, both being displayed and labelled to demonstrate results. This had a scientific as well as practical interest and attracted much attention.

The pottery exhibited by Messrs. Carter & Co., of Poole, was —as always—a great and beautiful asset to the exhibition, which they loyally support by sending annually a dignified and rich collection from their well-known and important Dorset industry. We wish that more of the *professional* industries would send specimens of their various handicrafts as samples of what the county can produce.

The County Assocation for helping the Blind took a large space at the exhibition, in order to advertise all kinds of work executed by them. Basket work was shown in great quantity and greatly appealed to the visitors.

It is impossible in a limited space to deal in detail with much of the excellent work sent by hundreds of individual exhibitors, a great deal being for exhibition only. The total amount taken in sales generally was as good as in previous years, but it was noticed that the articles purchased were of a less expensive nature, buying-power being reduced and people having to think twice before purchasing some of the more valuable and expensive articles. The total amount taken in the two days of the exhibition was £301 3s. 4d., the Association claiming 5 per cent. and the sum of £286 2s. 0d. being paid direct to the workers. This does not represent the entire amount of orders taken at the exhibition and not paid for at the time.

The fact that purchases could be taken away before the close of the exhibition has been much criticised. Formerly it was contrary to our rules. On account of the enormous increase in postal and transport rates, however, no one cared to incur the extra expense of subsequent delivery, which would in some cases have doubled the price of the article. Thus, when sales were invited, this rule had to be relaxed. In cases of class work, samples are reserved and shown for the purposes of securing orders.

The Dorset Federation of Women's Institutes.—The County Federation of Women's Institutes* and the Dorset Arts and Crafts work together, so that there is no overlapping. The Federation subscribes to the Association annually and the members are keen and interested competitors for the exhibition awards. Last October a "School" for teaching handicraft to members of Women's Institutes was held in Dorchester, which included classes for glove and slipper making, rush and basket work, cane and rush seating of chairs, upholstery, decorative needlework, thrift rugs, cobbling and soldering. Those who took lessons in any of the above crafts that are circulated in the Arts and Crafts Schedules, sent specimens of their work to our annual exhibition, and were only permitted to become instructors in the Women's Institutes if they obtained some award from the expert judges. The qualifying of thirty-eight teachers is the outcome of last year's "school," they having successfully passed the standard demanded by the judges in the Dorset Arts and Crafts Exhibition. It is proposed to hold another similar "school" this autumn. Besides sending to other exhibitions, the Dorset Federation held a stall at the Royal Counties Agricultural Show held at Bournemouth last June. The number of articles sent was 1,110 and the sales realised £150. A keen and lively interest was shown in the "Institute" tent by numerous visitors to the show from other counties. There is no doubt that, from an industrial as well as from a social and educational point of view, the Women's Institutes represent a very progressive movement which should bring prosperity and happiness to every village where they exist.

* See this *Journal*, September, 1921, p. 543.

AGRICULTURAL STATISTICS: THEIR COLLECTION AND USE.*

SIR HENRY REW, K.C.B.

Importance of Statistics.—It is not necessary to place before the Section of the British Association which is specially concerned in the advancement of agriculture, arguments to prove that statistical information lies at the basis of agricultural progress under modern conditions. It is quite true that improvements in farm practice and in farm live stock were made long before any systematic attempt was made to provide statistics of agriculture, and that scientific enquiry into the processes of nature in relation to soils, crops and animals, is not dependent on statistical data. It is, however, also true that the farmer, the stockbreeder and the scientist, are all limited in their outlook unless they know the magnitude and scope of the problems on which they are engaged.

All economic statistics have two primary objects, one general and the other specific. The general object is to provide information for the Government, for publicists and economists, of the extent and progress of that section of national activity to which the statistics relate, and the specific object is to provide information for persons who are themselves engaged in the enterprise recorded. In the case of agriculture, it is evidently important that full statistical information should be available for the Government and the public, and it is equally important that farmers and stockbreeders should be provided with it—although it must be admitted that they do not all appreciate or use it.

If one had a free hand and unlimited resources, it would be pleasant to construct a complete and logical scheme of statistics to provide all the information which it would be desirable or interesting to obtain. Such a scheme would be devised to show:—

The extent of land used, with details of its utilisation.

The capital value of the land, its rent and tenure.

The amount of capital—fixed and moveable—employed.

The amount of labour—manual, animal and mechanical—employed.

The number of individuals providing the capital, management and labour respectively.

* Paper read before Section M of the British Association at Edinburgh, 12th September, 1921.

These particulars would give the factors of production fairly completely, and we should then want particulars of the output:—

Weight and value of crops and animals produced and marketed.

Weight and value of meat produced.

Quantity and value of other produce—*e.g.*, milk, cheese, butter, cider, honey, &c.—produced and marketed.

Having obtained a complete account of the output in gross and detail of agricultural land, it would still remain to get further particulars of its distribution and realisation, including statistics of supplies at markets and of the course of prices.

It is unnecessary to remark that the scheme thus outlined is a counsel of perfection, and that in a world which is imperfectly organised and disciplined from the statistician's point of view, the ideal is never likely to be fully attained.

Historical Progress of Statistics.—Nevertheless, the world does move, and it may be of interest briefly to summarise the progress which has been made in this country, which may fairly claim to have been the pioneer in the development of a national system of agricultural statistics.

As I have elsewhere remarked, the earliest attempt to collect agricultural statistics may be attributed to William the Conqueror. No doubt the Domesday Inquest originated in the royal desire for revenue, rather than in a passion for statistics, but it nevertheless provided a detailed return of the use and equipment of the land.

"Every due of every wight
Within this England written stands
For all to read who have the sight:
Sokemen so many, tenants at will,
Cotsetters, men of tenant right;
The Kine, the pigs, the weirs, the mill;
Villeins with their oxen and plows."

The manorial records may perhaps be described as agricultural statistics, and had they been collected and collated would have formed a continuous return for the whole country. It is only within the past half-century that the economic historian has arisen and his labours have revealed the extent of information contained in these documents.

In the absence of statistics, attempts were made from time to time to make estimates of English agriculture. The estimate of Gregory King, made in 1688, is well known. In 1808, Mr. T. Comber, and in 1827 Mr. W. Couling, made estimates, the former giving the acreage under various crops

with an appearance of precision which the data available to him would scarcely warrant. We have no means of testing the accuracy of these estimates, but it may be said that in the light of present information they are at least plausible. The need for accurate statistical information was generally felt, and various attempts were made by private enterprise to supply it.

In 1831, the magistrates of Norfolk attempted, with a fair amount of success, to collect agricultural statistics for their own county from farmers. An attempt a little later by the Board of Trade to collect statistics in Bedfordshire—as an experiment—failed. Whether the different result was due to suspicion of Government interference, or to the fact that the Board of Trade enlisted the co-operation of the clergy as collectors of statistics, need not be discussed.

In 1845, further local attempts were made in England, Scotland and Ireland, respectively. In Scotland and Ireland they were successful, but in England they failed. In Ireland, this attempt formed the starting-point for the establishment of a national system of agricultural statistics, the necessity for which had been forcibly demonstrated by a disastrous famine.

In 1849, the East Berwickshire Farmers' Club made an agricultural census of that county, and four years later the Highland and Agricultural Society made a similar effort in three counties. In 1854, the Society undertook on behalf of the Government, and with a grant from public funds, to collect statistics of acreage and produce for the whole of Scotland. This was repeated in the three following years, when owing to difficulties with the Treasury the scheme was discontinued.

Official Statistics.—In 1864, Sir James Caird carried against the Government of the day, a resolution in the House of Commons in favour of the collection of official agricultural statistics, and two years later the Board of Trade started the returns of acreage and live stock which have been since continued. Twenty years later—in 1885—annual estimates of the produce of certain crops were instituted. When the Board of Agriculture was established in 1889, the collection of agricultural statistics was transferred to it, and came under the charge of Major Craigie. Under his direction the system was gradually improved and extended, and after he left the public service the tradition which he established led to further developments, so that it may fairly be claimed that we now have in this country a system of agricultural statistics which, if not yet as complete as many of us would wish, is within its limits

probably better than in any other country. It has, indeed, formed the model on which many other countries have founded, or revised, their methods. Starting as we did, before most other countries, profiting by the lessons of long experience, and with so small an agricultural area to deal with as compared with most other countries, it would indeed be disappointing if we did not occupy a foremost place in this respect.

The basis of our agricultural statistics is the return obtained in June each year from every occupier of an agricultural holding of over one acre. This gives the acreage under each crop and the numbers of live stock of different classes on the holding at the date of the return.

Prior to 1917, this return was voluntary, but it was made compulsory by the Corn Production Act of 1917. There appears to be an impression in the minds of some that this alteration has affected the consecutiveness of the annual returns. This can only arise from unfamiliarity with statistical work on a large scale. Under the voluntary system there were some refusals, or failures, to make a return. The proportion varied in different districts, but over the whole country only about 3 per cent. of the total number of occupiers failed to fill up the form or to give the collecting officer information to enable him to do so. I have actually been asked whether the absence of this 3 per cent. implied that the totals published for the whole country were deficient to this extent, as though it were possible for any reasonably honest person to put his name to a statement purporting to give a total which he knew to be untrue. It is hardly necessary to say that it was part of the collecting officer's duty to furnish an estimate of the crops and live stock on any holding for which he failed to get an actual return. The fields and live stock of a farm are, broadly speaking, visible to anyone, and with the aid of the rate book it is not very difficult to make a fair estimate within a reasonable margin of error. The presence of 3 per cent. of such estimated returns could not seriously affect the validity of the totals.

It is also urged that a compulsory return is more accurate than a voluntary one. This is probably so in some degree, though the additional accuracy may easily be over-estimated. The important point is the absence of deliberate bias. If the persons making the returns have an interest, or think they have, in under-statement or over-statement of the figures, it may be confidently assumed that the returns as a whole will

give a result below or above the true figures. This will happen whether the return is voluntary or compulsory. To take a familiar instance. The Census returns are compulsory, but it is well-known that certain female age-groups are definitely inaccurate by reason of a general tendency to under-state the age. Any financial interest provides a still stronger motive.

In stating the acreage under each crop and the number of each class of live stock, the individual has no obvious reason for deliberate misstatement, and it is on the whole easier to give the true figures than to invent others. As the total acreage of the farm is taken from the rate-book and the sum of all the crops must make that total, a certain amount of trouble, for which there is no sufficient motive, is involved in compiling a statement which is untrue in detail.

While, therefore, I agree that compulsory returns are on the whole more accurate than voluntary returns, as well as more complete, the effect on the general total is practically negligible in a comparison of figures collected under both systems.

Returns of production of crops were first collected in 1885. In the nature of the case they cannot be obtained in June, but must be collected after the crops are gathered. They are, in fact, obtained in mid-October for the corn, pulse and hay crops, and in mid-November for potatoes and roots. The collecting officers are supplied with schedules giving for each parish the acreage of each crop as returned in June, and their duty is to enter the estimated average production per acre of each of the crops. They are instructed to arrive at their estimate after enquiries of growers, thrashing machine owners, valuers, &c. Much, however, obviously depends on the judgment and experience of the collecting officer.

It is sometimes objected that estimates are not ascertained facts—which is undoubtedly true. The system may be sufficiently defended on the ground that no other is practicable, but, in fact, it may also be claimed that no other is superior. Two other methods are possible. One is to obtain a return from every grower, and the other to rely on the ascertained results of a number of sample plots. A return from every grower would, of course, involve more trouble and expense and greater delay, but apart from this there are objections. In many cases the grower has no accurate record of the quantity of the crops—especially such crops as hay and roots which are consumed on the holding—but assuming he has the exact figures the difficulty

to which I have referred above arises. It will hardly be denied that there would be a constant bias in the returns from growers. Farmers as a class have an inherited tendency—bred of long generations of tenancy—to under-state the results of their farming. This unconscious mental bias, for which there is no reason under modern conditions, may be dying out, but there still remains the possibility of conscious bias. It is clearly in the interest of producers that any published returns of the year's harvest should not over-estimate the crops. The shorter the yield the better the price, may not always hold good in relation to products which are subject to world competition, but nevertheless it is an economic axiom which no producer is likely to overlook. If he is asked to make a return of quantities which he does not himself precisely know at the time of the return, it is obvious that he will take care to err on the side of caution. The cumulative effect of these tendencies upon over 400,000 returns would be substantial and the whole results would be invalidated.

Statistics of crops based on the quantitative results of sample plots are in theory not open to similar objection, but in practice it would be extremely difficult to arrange a system which would give accurate arithmetical results. Not only would the plots have to be so distributed as to represent all conditions of soil and situation for each crop, but the number of plots representing each variety of soil and situation would have to be proportionate to the whole area on which similar conditions prevailed. The yield of wheat given on heavy clay plots, for example, would have to be weighted by the total area of heavy clay land on which wheat was grown that year—and so on. Differences in manuring could to some extent be allowed for, but it would be difficult to make proper allowance for differences in cultivation. The sample plots would naturally tend to be above the average in cultivation, and especially in cleanliness.

From the collecting officers are obtained estimates of the natural weight of grain and of the yield of straw. They have also to furnish monthly reports on the appearance of the crops, and the general agricultural conditions, and to make forecasts of the probable yield of crops during the later periods of their growth.

Parliament has always been indifferent in regard to the collection of statistics. If this country does possess a system of economic statistics of which on the whole it has no reason to be ashamed, the fact is attributable to the persistent efforts of a few individuals, such as Sir Robert Giffen, Sir Alfred

Bateman, and their successors at the Board of Trade, and, in the sphere of agricultural statistics, Major Craigie, who have taken opportunities as they arose (the opportunity usually being the advent of a sympathetic and progressive Minister at the head of the Department) to obtain authority for a development of the statistics for which they were responsible. An enumeration of the population might, one would think, be regarded as an elementary need for the administration of the affairs of a civilised community, but it was not until 1801 that the Government decided to take a Census. A striking exception to the normal apathy of Governments and Parliament towards statistics and the ascertainment of economic facts, was the passing of the Census of Production Act in 1906.

I have already pointed out that official agricultural statistics were established and developed on the basis of a resolution of the House of Commons carried against the Government, and that it was not until 1917 that they were recognised by Act of Parliament, and then only because the State was incurring certain liabilities which necessitated returns of the acreage of wheat and oats.

There is, however, one class of agricultural statistics which has been collected under statutory authority for many years. In 1685, an Act was passed for the half-yearly settlement of the average prices of corn, and sixteen enactments having similar objects were passed at different periods from 1731 to 1882. Indeed, in connection with the Assize of Bread, there was a system of recording the average price of wheat as early as the thirteenth century. The latest Act under which the official prices of wheat, barley and oats are now ascertained, is the Corn Returns Act, 1882, which has in many respects become antiquated and the amendment of which has long been overdue. Its provisions have been further complicated by the Corn Sales Act recently passed. In Scotland farmers' prices have been fixed under statutory authority for about two hundred years.

Prices of other agricultural commodities have been for about 18 years collected and published weekly in the "Return of Market Prices." The system of collection, broadly, is that of the selection of a number of representative markets and the appointment of an official reporter who makes a return of the prices realised. A special feature of this Return is that the various local weights and measures used in the markets are

converted to a common standard, so that the prices in different markets may be readily compared. In my judgment, the practical value of this Return to the farmer in the conduct of his business is not sufficiently recognised. About 20,000 copies are distributed weekly, but they represent only a small proportion of those for whose use it is designed.

I have not exhausted the catalogue of returns, periodical or occasional, which may be included under the term "Agricultural Statistics"—the most important omission being the "Return of Agricultural Output" obtained in connection with the Census of Production. I hope it may be possible to repeat this, as originally contemplated, every five years.

My views on English Agricultural Statistics may no doubt be coloured by the fact that I have taken some part in their development. Others less influenced by parental feelings may not agree that the principles and methods on which they are based are unchallengeable. One may fully admit that they are open to discussion, but it may be claimed without hesitation that they are the result of very serious consideration in the light of long experience, and with a full knowledge of all that has been done in the same field by other countries. That the system is not perfect, is to say that it is the product of human effort, and it must be remembered that it was devised and extended under financial limitations of a much more stringent nature than have been recently imposed. "A fool can govern in a state of siege," says an old proverb, and it is not difficult to construct and administer admirably complete schemes if one can do so regardless of expense. With the resources available the British system of Agricultural Statistics (the English and Scottish systems being practically the same) is based on sound and practical lines.

Use of Statistics.—The subject of this paper was chosen by the Chairman, and I have not yet dealt with the last word of it. I have dwelt so long on the collection of agricultural statistics that there is little time to expatiate on their use.

The proposition that statistics are useful commands general assent at the present time. The old popular belief that official statistics were mainly intended to provide more or less amusing occupation for officials, and to furnish opportunities for elaborate perversions of the truth, has been in some degree weakened by the War. There is now, in fact, a popular demand for statistical information of all kinds, and the demand, as usual, produces the supply. If the information does not in fact exist

—as is frequently the case—it is forthcoming nevertheless from the fertile brain of an up-to-date journalist. Even in ordinary conversation one is constantly confronted with statistical "facts" in relation to subjects on which no statistics exist!

In this really lies the best reply to the question: "What is the use of Agricultural Statistics?" They are of vital importance to the producer. His whole business depends on information of the present and prospective supplies of the products which he has to sell. If that information is not obtained independently and completely, the enterprise of traders will furnish statements as to the supplies available which will not be compiled in the interests of producers, but which there will be no means of checking or contradicting. Similarly, the trader who is daily in the markets must necessarily have a wider knowledge of current prices than the producer who attends only one market occasionally. An independent record of market prices must therefore be advantageous to the producer.

Broadly, therefore, the main use of agricultural statistics is to supply, as far as humanly possible, facts, and thus to prevent the promulgation of statements which are inaccurate and interested.

To the administrator, the economist, and the sociologist, statistics of the use of land and the distribution of its products are indispensable to any intelligent survey of the economic life of the nation. Agriculture may no longer be the predominant factor in the national life, but it can never cease to have an overpowering significance in relation to the health and wealth of the people, and full records of its varied activities are essential to its maintenance and development.

A FRUIT DEMONSTRATION STATION IN EAST SUSSEX.

A. H. HOARE,
District Inspector of the Ministry.

THE value of fruit demonstration stations as a part of the horticultural education programme of County Councils is freely acknowledged, and this country does not lack instances of actual proof of this statement.

It is important, when speaking of *demonstration* stations, that the functions of such centres should not be confused with those of *research* stations. Their main objectives should be the practical demonstration of the best known cultural methods coupled with the gathering of information as to the behaviour of varieties, particularly the recognised commercial varieties, under local conditions of soil and climate. The information so obtained—and it is often obtainable with a minimum of expense—will be of inestimable value, and as a means of stimulating the production of home-grown fruit can hardly be overrated.

The establishment and outcome of one of the earlier fruit demonstration stations in the county of East Sussex is described below. In the year 1905 the education authority of the county considered, for the first time, the question of establishing fruit demonstration stations in those parts of the county where it was considered fruit growing was capable of development. The Horticultural Instructor, Mr. W. Goaring, was asked to report as to the suitability of the various districts for fruit growing and the possibility of establishing stations.

One such district which came under consideration, and was thought to be highly suitable for fruit growing, was that surrounding Frant on the borders of Kent and East Sussex. A piece of land was selected on the farm known as Lightlands, which is part of the Eridge Castle Estate. This piece of land, about one-quarter of an acre in extent, was part of a 7-acre field, the soil of which was a stiff loam overlying clay. The general situation was very favourable, the land sloping gradually to the south-west with belts of trees and undergrowth forming natural windbreaks upon the north and east boundaries.

As the result of negotiations with the estate agent, a remarkable and interesting agreement was made between the landlord and the County Council. Its main provisions were as follows :—

The Landlord agreed:—

1. To let the land to the Council for the purpose of a fruit demonstration station at an annual rent.
2. To erect and maintain a post and wire fence around the area.
3. To provide all the labour and farmyard manure required to carry on the work of the station. The said labour not to include that required for pruning and washing the trees.

The County Council agreed:—

1. To provide all fruit trees and bushes and plant the same in their quarters.
2. To fix and maintain a rabbit-proof wire netting in association with the landlord's post and wire fence.
3. To prune and wash the trees and bushes, and to provide all manures other than farmyard manure.
4. To hand over to the landlord all fruit grown with the exception of twelve fruits of each apple and pear tree and a small portion of the fruit of each bush.

The general supervision of the station was vested in the Horticultural Instructor.

With the signing of this very equitable agreement, the work of developing and planting the station was proceeded with, and in the year 1906 all the trees and bushes were established in their positions.

It was decided that two trees of each selected variety of apple, pear and plum should be planted at a distance of twelve feet apart each way. The following varieties were selected:—

Apples.

Bramley's Seedling.	Lord Derby.	Newton Wonder.
Lord Grosvenor.	Grenadier.	Warner's King.
Gascoigne's Scarlet.	Golden Noble.	Royal Jubilee.
Charles Ross.	Annie Elizabeth.	Ecklinville.
Adam's Pearmain.	King of the Pippins.	Ribston Pippin.
Allington Pippin.		

Pears.

Doyenné du Comice.	Beauvre d'Amalis.	Josephine de Malines.

Plums.

Emperor.	Czar.	Monarch.

The station made excellent progress from the outset, and in four years from the date of planting the trees were nicely developed and soon afforded an opportunity of judging the worth of each variety for the particular locality.

The information thus gained proved invaluable, and it was not long before a general planting of fruit in the district was begun. One of the first to make a start was the landlord himself, who, upon seeing the satisfactory development of several varieties of apples, had the remainder of the seven acres planted up. Others followed suit.

It will not be out of place to repeat the statement made at the commencement of this article that the chief value of demonstration lies in the information obtained as to the varieties best suited to a district. The cost of establishing a station, when compared with the general benefit accruing to the district and the subsequent gain to the country in home-grown fruit, is almost infinitesimal.

The writer had an opportunity of inquiring into the subsequent history of the 7-acre field planted by the landlord. Accurate accounts have been kept and it will be of interest to give the yields of fruit for the last four years. The figures are as follows:—

Year	1917	approximately	2,000	bushels of apples.
„	1918	„	1,000	„
„	1919	„	3,700	„
„	1920	„	500	„

The year 1920 was, of course, a bad year for apples in the south.

The present tenant of Lightlands, who is an old pupil of Uckfield Agricultural College, has largely extended the area under fruit. Fruit has similarly extended in the rest of the district, which prior to 1905 produced practically no fruit on a commercial basis. A fruit demonstration station could scarcely have accomplished more good in such a small space of time. It might be maintained that but for the pioneer work of the County Council, no fruit would yet have been grown in the district. The original station having now become a fully developed fruit plantation, and having, as stated above, achieved its object as a demonstration centre, the agreement with the landlord is about to be terminated.

THE STRAWBERRY CROP, 1921.

ISAAC WALTON, "The Compleat Angler," is accredited with saying of the Strawberry, "Doubtless God could have made a better berry but doubtless God did not." The lapse of years, the introduction from abroad of new and strange "Fruits of the earth," the phenomenal development of new varieties of fruit indigenous or acclimatised here, together have failed to dethrone the strawberry, in her season, from the regnant place in public favour implied in Isaac Walton's apostrophe.

The term "strawberries and cream" to many denotes the peak of attractive deliciousness during the short period of six weeks or so when the strawberry, crowding the markets, monopolises the attention of fruit sellers and buyers, and impresses the very atmosphere of the markets with its characteristic odour.

It is traditional that the public gives little consideration to links in the chain of production, transport, and distribution, along which travels the produce purchased at store or barrow. It grumbles at price, waxes sarcastic at the expense of the grower, or somebody else, when fruit is presented to it improperly packed, or in a damaged condition; but it has not the time nor the means to probe the matter through its successive sequences and find an answer to the "Why?."

It is time the public should be better informed, in order that it may be better served, for the dynamic force of public opinion is needed to help those who are striving to replace antiquities that are wasteful as well as obstructive, by methods of organisation sane, sanitary, and saving.

Most of the strawberries marketed in this country are raised in districts where the soil, climate and environment are suitable for the proper cultivation of the plants.

Kent, Wisbech Area, South Hants, Tamar Valley, Cheddar Valley, Middlesex, Surrey and Essex are the principal growing districts, and growers in each area take great pride in their local products, each considering their own to possess a better flavour than fruit produced in other parts. So does human nature help to bias judgment.

Most of the men engaged in this industry are the small-holders and ex-Service settlers on the land who on a few acres have settled down in earnest to secure an honest living by hard work and long hours in planting and caring for the strawberry plant. Much care is needed if the fruit is to be grown to perfection and commercial success achieved. Before planting the soil has

to be most scrupulously cleared of weeds, thoroughly cultivated, and brought to a "good tilth." The beds when planted must receive constant attention; and the successful grower must be ever stirring the soil to keep the surface loose and friable and at all times free from weeds. Much manure is needed and large crops cannot be gathered unless the ground has been adequately—one might even say abundantly—supplied with its proper quota of nitrogen, phosphates and potash. Lime is also necessary.

The crop produced, of course, varies with the treatment, class of soil, season, variety, and to some extent the district. This year, owing to the drought, the crop was unduly early and the season a short one. The yield varied; the Tamar Valley averaged nearly 2 tons to the acre; Cheddar, Hamsphire, and Wisbech not more than 25 cwt. per acre.

As the harvest season approaches the worries of the grower increase. The fruit is very tempting to boys, birds, and slugs. Each invasion must be met by its appropriate defence. Probably his greatest trial is at picking time. Picking commences at sunrise and is continued throughout the day until the dispatch of the trains to the market centres. During all this time everything is hustle—there is short time for sleep at night for anyone concerned, and no rest by day.

Where the holdings cultivated are not more than 6 or 7 acres in extent the picking may be managed by the grower and his family; up to 10 acres the help of neighbours may suffice; but for the picking on larger holdings there is an immigration of "pickers" attracted from various social classes. The preparation of accommodation for pickers in advance of their arrival, and the management of them when arrived constitute the most serious test of the grower's organising capacity and resource. At the conclusion of the picking season preparation for the production of next year's crop commences immediately.

A small proportion only of the fruit is consumed in the producing districts; the bulk has to be packed and sent to markets all over the British Isles, and, owing to the perishable nature of the berries, transport must be smooth and expeditious. This year the occurrence of the coal strike gave rise to fears of interference with the punctual distribution of the crop, and in order to help the growers, and to facilitate the best possible organisation of transport the Ministry stationed Inspectors in certain strawberry producing centres. These Inspectors kept in close touch with the growers, the Growers' Associations and the Rail-

way Companies, and were thus able to render assistance which appears to have been much appreciated by those concerned.

The Inspectors, being in touch with the business of picking and dispatch of the fruit, were able to study local methods and to note especially the kind of package used in each district, the type of van provided by the various Railway Campanies and the treatment meted out to the produce during transit. A large amount of valuable information was collected and it is now possible to publish facts of some importance which the general public as well as all those engaged in the industry should know. It is hoped that a study of these facts may lead to further developments, and in particular, to the general adoption of a standard package, to better method of packing, and to more adequate and appropriate means, as well as methods of transport.

Packages.—The growers, speaking generally, use for strawberries a light basket, made of veneer, called "chip." It is light in weight and proportionately small in cost. The question of uniformity in size has received but little consideration. It is probable that baskets of some 12 or 15 different sizes are in use, which naturally hold different quantities of fruit; the baskets of fruit, moreover, are seldom weighed before dispatch. Such a lack of system is bound to cause confusion on the market, bewilderment to the buyer, and increased cost to the consumer. For example the Tamar Valley uses a locally-made basket holding about 3 lb. of fruit; the Hampshire and Wisbech growers use a very slightly larger basket which is sent to market as a 4-lb. basket; Cheddar growers use a larger basket into which they pack 4 lb. of fruit; Kent and Middlesex growers use the 1-lb. chip punnett for "dessert" quality and the 10-lb. pock or tray for "jam" fruit. The confusion could be avoided, the bewilderment cleared and the cost to the consumer lessened by the adoption of a "standard" basket, and withal, the grower would stand to gain. Which is the best size of basket to use? Should it hold 4 lb., 3 lb. or 2 lb. of fruit? To settle these questions all sections of the industry must confer together, and decide upon a basket that will be acceptable alike to growers, wholesalers and retailers. Judging from the observations of the Inspectors as well as from other indications a basket large enough to permit of 3 lb. being packed so that the top of the fruit is below the level of the rim, would appear to be the most likely to gain general acceptance.

Again, a cover is usually placed over each basket of fruit, particularly for transport by railway. For this purpose, muslin,

grease-proof transparent papers, dull papers and cardboard are all used. The particular type chosen depends more on local custom than on merit. The Ministry's Inspectors point out that paper covers have many disadvantages; they give no protection to the fruit, moisture or heat is unable to escape, and buyers in the market have to tear the paper to see the quality of the fruit. Muslin is superior to paper and generally gives satisfaction, except where the fruit is subject to rough treatment during transit or in the markets. For general use a cardboard cover or a very light chip-wood cover would be preferable because of the added protection that would be afforded to the fruit. This again is a matter on which the whole industry should agree.

Transport.—Where the grower can deliver the fruit in his own vehicles to the markets the transport problem is simple. The growers of Kent and Middlesex delivered by motors a very large quantity of berries to the London markets, and smaller quantities were sent in this way from Hampshire, Wisbech and Cheddar. This method of transport achieved such successful results that it is possible to foresee that the motor will become, in the near future, a serious competitor of the railway for the transport of soft fruit.

The Railway Companies, though confronted this year with additional difficulties in consequence of the coal trouble, strove in a whole-hearted manner to cope with this seasonal and very difficult traffic, and generally gave satisfaction. The Great Western Railway Co. kept the Cheddar Valley supplied with an adequate supply of vans nicely fitted with shelves on which the baskets of ripe strawberries were placed. Incidentally here it might be mentioned that the Cheddar growers fasten four baskets together with a stick tied across the handles. The stick gives support to the frail basket and helps to keep it in place and affords valuable protection to the contents; further time is saved in packing the vans as a porter can by this means handle 8 baskets at a time. The South Western Railway Co. supplied to Hampshire a large number of vans also adequately and properly fitted with shelves, and fruit properly packed in these travelled without damage. From this district a few vans were sent off with the baskets packed on top of each other six or seven high in the van, with no shelves. The Company did this as an experiment, and they have expressed themselves satisfied with the result on the ground of costs saved. Judging, however, from the reports of growers and salesmen the fruit in the lower layers of baskets was very much damaged. Should the vans used for this traffic,

therefore, be fitted with shelves? The condition of the fruit on arrival at the market must be the deciding factor, and judging from this it appears that shelves are necessary.

The Ministry will continue to give consideration to this matter, and will strive to secure the best possible conditions.

The figures collected by the Ministry show that the approximate quantities of strawberries railed from the various producing centres were as follows:—

Tamar Valley	293	tons.
Cheddar	214	,,
Hampshire	2,056	,,
Wisbech Area	3,225	,,

Large quantities were also sent from Middlesex, Kent, Hereford and other centres for which figures were not obtained. The total of all these figures is considerable, yet the supply this year was little more than sufficient to satisfy the demand for fresh fruit leaving very little for the jam manufacturers. The danger of over production is not yet in sight.

CONTROL OF "DAMPING OFF" AND "FOOT ROT" OF TOMATOES.

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In a previous issue of this *Journal* (October, 1920) attention was drawn to the important disease known as "Damping off" and "Foot Rot" of tomatoes. The relation of its intensity to different cultural conditions was indicated and it was shown that it could be controlled by sterilising the soil, seedboxes and pots by means of heat or formaldehyde.

Many growers, however, do not find it convenient to adopt such methods, but rather desire some remedy which may be effectively employed to check the spread of the disease should it appear. As the result of continued investigation such a remedy has been found, which for convenience has been named "Cheshunt Compound."

Preparation of the "Cheshunt Compound."—The compound contains 2 oz. of Copper Sulphate and 11 oz. of Ammonium Carbonate. Powdered copper sulphate and ammonium carbonate should be obtained, reduced to a fine state by crushing out any lumps that may be present and then thoroughly mixed in the proportions given. Larger quantities may be prepared, so long as the proportions remain the same. The mixture may be stored in the dry state in an air-tight receptacle, but if left exposed to the air it gradually loses ammonia and becomes less potent.

Mixing the Solution.—The dry mixture should be stored for 24 hours in a tightly corked glass or stone jar before using. The solution is then prepared by dissolving 1 oz. of the dry mixture in a little hot water and making up to 2 gallons with water. The solution must not be put into vessels of iron, tin or zinc, as it would corrode them and lose its strength, and only just as much as is required for immediate use should be prepared.

Method of Use.—Plants which are already attacked receive no benefit from the solution but eventually die, unless the healthy tops are cut off above the diseased part and treated as cuttings. It is possible, however, to kill the infective organisms by watering infested soil with the solution, after which immediate planting may follow without in any way harming the plant. It is possible, also, to treat infected soil with plants *in situ*. The solution effectively destroys the disease organisms and at the same time increases the vigour of the plant. When the soil

is suspected of being infected the following methods should be adopted :—

(a) *Seed-boxes.*—The soil should be thoroughly watered with the solution after sowing and covering the seeds. Generally a pint per box (14 by 9 by 2 in.) is a suitable quantity to use.

(b) *Pots.*—The young seedlings should be planted and watering with the solution should follow immediately. To enable sufficient solution to be given to each plant, the level of soil should be one inch below the level of the pot. Care must be taken to treat the seedlings immediately after they have been placed in the infected soil. If left overnight before treatment, many will be infected and the treatment will be rendered useless.

(c) *Houses.*—Each plant should be removed as it is attacked, the hole watered with one pint of solution, a healthy plant inserted and watering with the solution should again take place.

The solution has a beneficial effect apart from killing the disease organisms, for the nitrogen which it contains imparts greater vigour to the young plants.

The treatment described above has proved of value against "Damping off" of many seedlings besides the tomato, but in the case of very delicate seedlings it is necessary for the solution to be more dilute. Preliminary experiments with the compound upon other root diseases have also proved satisfactory.

PROTECTION AGAINST FUNGI FROM ABROAD.

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THE dispersal of newly-introduced fungi is a most interesting and still largely unexplored subject. Certain facts stand out, however, as to the extent and range of dissemination of disease. It is certain that in many cases extension has been checked by natural barriers when human factors have not intervened. The Chestnut Blight disease in New York was for ten years confined on its western boundary by a rough mountainous tract some thirty-five miles broad where no chestnuts grew; and with regard to White Pine Blister Rust, American pathologists are still hoping that it will not cross the Rocky Mountains.

In many cases it is possible to trace the human agency whereby the disastrous disease has entered in. In the natural course disease will pass, by spores borne by wind or animals or in other ways, over a distance of some ten miles. Very occasionally a jump is made, and an unexplained arrival appears a hundred miles from the nearest known source of infection—over continuous land; but crossing a vast expanse of sea or leaping over hundreds of miles unassisted by human transport in boat, train or wagon, apparently only occurs in the imaginations of early writers.

These facts lie at the root of the attempts now being made almost throughout the world to prevent the entrance of dangerous new parasites into clean areas. In England we have been exceedingly deliberate and have given much consideration to the matter, but the time has now certainly come to try to prevent further pests from entering the country. The new Destructive Insects and Pests Order of 1921 gives effect to the general opinion of experts and growers calling for legislative action.

As far as new fungi are concerned, England has little to fear from Europe, free intercommunication having introduced most species which will thrive in the country. The greatest danger is to be feared from new importations from the east or from America. Japan has now a Phytopathological Service and the enormous attention that the United States of America pays to the science of plant pathology and to the whole subject of the control of plant diseases is well known.

A sign of the times is the co-operation which is rapidly strengthening between plant pathologists in all parts of the

world, and as a result the assistance which these workers render, both to the welfare of their own countries and to those of others, is very hopeful. Invitations have been extended to European workers to visit important field conferences in America and an international phytopathological conference in Europe is being planned for 1922. Another hopeful sign is the increased interest given to Disease Surveys, every progressive country now endeavouring to draw up an accurate and yearly statement of the situation with regard to plant diseases. The Survey reports are invaluable, not only in showing how diseases are controlled in other countries, but in forming a basis for legislative measures.

In the northern part of the United States many crops are the same as our own and American experience shows us the urgent need of taking precautions against certain virulent diseases present there but absent in Britain. The four following are dealt with in the new Order:—

1. Chestnut Canker (*Endothia parasitica*).
2. Downy Mildew of Hops (*Peronoplasmopara humuli*).
3. Pear Blight (*Bacillus amylovorus*).
4. Black Knot of Plum and Cherry (*Plowrightia morbosa*).

The two other scheduled diseases, Wart Disease of Potatoes (*Synchytrium endobioticum*) and Onion and Leek Smut (*Urocystis cepulæ*), are in a different category.

Wart Disease.—Wart Disease is here to our cost, but its distribution is known and the rules that are laid down for the entrance of potatoes from abroad are in accordance with the regulations that are laid down for its control in England. With the exception of new potatoes for immediate consumption it is required that they must be accompanied by a certificate stating that "Wart Disease has not occurred at the place where the potatoes were grown, nor within five hundred yards thereof."

Onion Smut.—The Smut disease of Onions and Leeks is at present very rare in England and "localised at a few centres." There is good reason to suppose that at least one of the recent new infections was introduced with foreign seed. At any rate it has been proved that this disease can be carried with the seed and therefore extra care is required. Onion Smut is common in America in many of the onion growing districts and is also present in Italy and France. The fungus acts as a soil parasite and remains in the soil for many years, attacking each successive sowing of onions or leeks.

Chestnut Blight.—At present it is possible to say that we have not seen a case of *Endothia parasitica* in England. Large

woods of Spanish Chestnuts are not usual in England, but the tree is grown extensively for coppicing for the production of hop and other poles.

The devastation caused by the Chestnut Blight in the United States is now well known. About 1904 a new bark disease was noticed on the Chestnut near New York. A few years later the losses caused by this one disease were estimated at £10,000,000 and have continued since; yet the parasite is practically harmless in China and Japan whence it came. Dr. W. A. Orton, one of the leading American pathologists, says that "Europe should take warning and exercise every precaution to prevent the introduction of this disease." *

In Pennsylvania some pathologists are now proposing to cut down every Chestnut tree in the state as "for the last fifteen years all efforts to control Blight have failed."†

The appearance of this disease is very characteristic. At first yellowish brown patches, slightly raised, stand out on the smooth healthy bark. Under these patches, if the bark be torn away, can be found the white, spreading fans of mycelium which form a distinctive diagnostic character. In damp weather the tendrils of spores push forth like so many thick buff-coloured or bright yellow hairs—they curl and twist and are soft when wet but hard and brittle when dry. We have other diseases in this country caused by fungi of the nearly allied families, but none so devastating in effect.

Downy Mildew of Hops.—The least known of the forbidden diseases is the Japanese Downy Mildew, *Peronoplasmopara humuli*. This was seen in Japan in 1905 when it spread rapidly over a hop field near Sapporo. It was found on the picturesque Japanese wild hop a few months later and was evidently native to Japan.

The leaves show small spots, angular at first, of a darker green than the rest of the leaf, and having a water-soaked appearance. Occasionally small blisters and bumps occur on the adjacent parts of the leaf. Gradually the colour deepens and then, with the death of the tissue, becomes dark brown and on the under surface a thick, downy growth forms which is white, but becomes greyish, resembling somewhat the fluffy growth of *Phytophthora* on the potato. This disease a few years later was found in the State of Wisconsin in various localities and evidently spreading.

Should this disease reach England and spread to the hop-

* Orton, Phytopathology. Vol. IV, No. 1, February, 1914.

† *Amer. Nut Journ.*, XII, p. 91, quoted in *Botanical Abstracts*, May, 1921.

gardens of Kent, what a field for mischief it would find! The damp climate of England would probably suit it, and the well nourished and well tended Kentish hops would, in all likelihood, furnish the most acceptable of hosts to that type of parasitic fungus.

Fire Blight.—The growing of susceptible pears in some parts of the United States, notably in southern New York State, is rendered unprofitable by the devastation caused by the Fire Blight, a bacterial disease due to the organism *Bacillus amylovorus*. Dr. H. H. Whetzel, the Professor of Plant Pathology in Cornell University, says "Fire Blight is the most universally destructive of all pomaceous fruit diseases." Dr. C. R. Orton may also be quoted as stating "The losses from Fire Blight run into millions of dollars in certain years in this country."

This disease occurs on Pears, Apples and Quinces. It is most destructive to young apple trees in the nursery and to older pear trees. There are four prevalent forms :—

(*a*) *Fire Blight* itself, which is a twig blight. The leaves, blackened as if by fire, cling to the blighted twigs. Sometimes only the apex is black, sometimes the destruction extends two or three feet back.

(*b*) *Blight Cankers* slightly sunken and blackened with a cracked rough edge delineating the morbid from the healthy tissue.

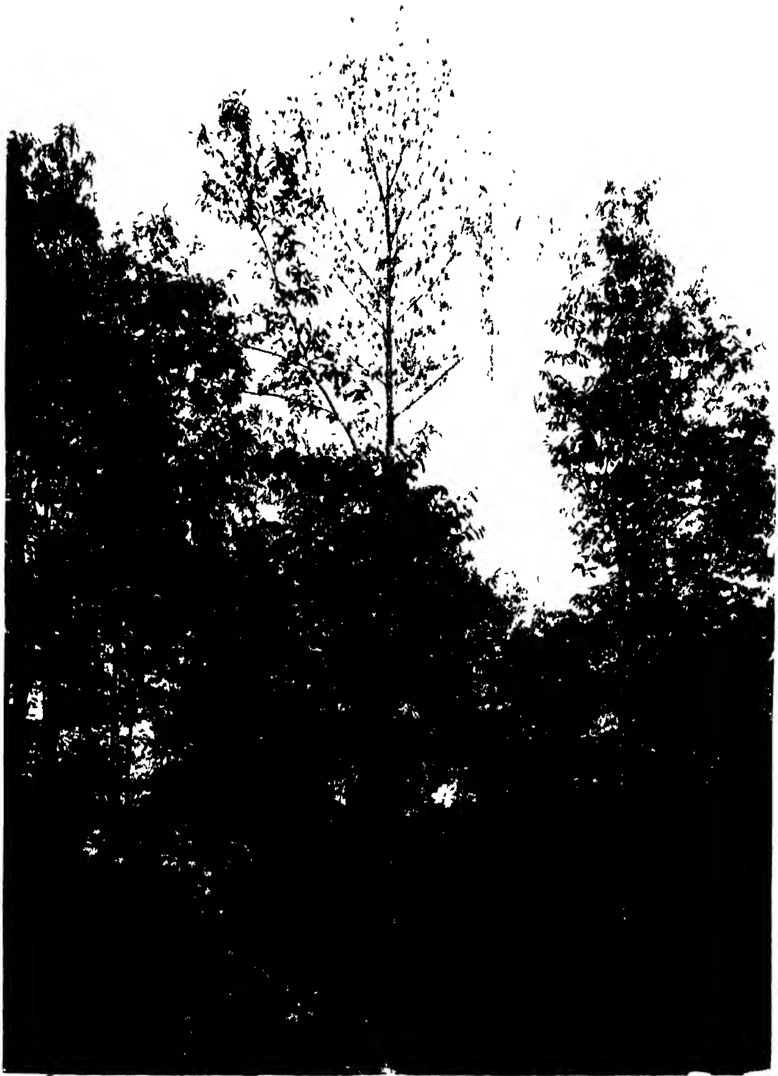
(*c*) *Blossom Blight* causes the flowers, dead and brown, to hang on the withered spurs.

From each there oozes, in wet weather, the sweetish, sticky, brownish-white fluid which bears the millions of bacteria.

(*d*) *Collar Blight*, the canker attacking the trunk of the tree, is particularly common on apples.

The appearance of the trees reminds one of an intensified attack of Blossom Wilt or Wither-tip, but the leaves are blacker, the flowers more scorched-looking, the effect more severe. A definite ooze is, moreover, usually present as drops on the diseased fruit or welling out from cracks in the twigs and diseased boughs.

Black Knot.—A disease which, like the Chestnut Blight, has so far never appeared in England, is the striking and unsightly Black Knot of Plum and Cherry (*Plowrightia morbosa*). This abounds on the wild plums and cherries in the United States of America, both on the native plums (including the tall Red Plums and the straggling Beach Plum a foot or so high) and on the introduced sloe or blackthorn, which is very common along the snake-fences and edges of the roads in New England. Cherries,



Photo] [*J. T. Kok.*

FIG. 1.—Chestnut Blight. Top of Chestnut Tree killed by the fungus *Endothia parasitica*. The dead leaves remaining on the tree are characteristic of the disease, they turn white and papery.

FIG. 2.

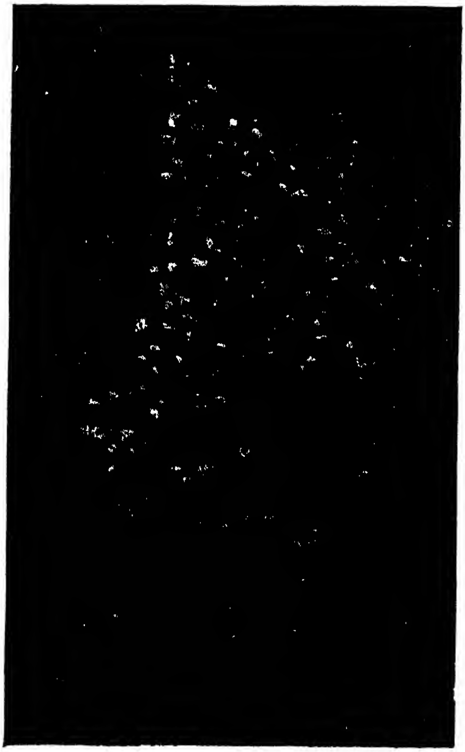


FIG. 3.

FIG. 2.—Chestnut Blight. Conidial Stage of *Endothia parasitica.* Cankers produced by artificial inoculations, the rings show size of canker at intervals of 4 weeks.

FIG. 3.—Chestnut Blight. Perithecial Stage of *Endothia parasitica.*

FIG. 4. Black Knot of Plums. The early stage (left) is light-brown, the later perithecial stage is black and carbonaceous.

FIG. 5.—Fire Blight in Apple. Commencement of attack. The leaves die and turn black, and the branch may die back several feet.

of which there are two or three wild kinds, are also often distorted and injured by the black galls.

The knots occur sometimes at the end of twigs but more often on the smaller branches, where they grow most frequently along the branch in a slow spiral. Occasionally they entirely encircle the bough, forming a complete girdle, and the bough soon dies.

These black galls so check the nourishment of the branch on which they occur that the branch usually dies within a couple of years. The lumps or excrescences are light yellow-brown in the spring and early summer, turning black and charcoal-like in the autumn. The fungus produces spores of two kinds, a summer (conidial) spore from the light brown mass and a different winter (perithecial) spore from the knotty, black autumn stage.

These four diseases are of outstanding danger, but there are several other well-known diseases on fruit-trees, cereals and ornamental plants in various parts of the world which may, if introduced in the British Isles, become extremely troublesome, but which at present do not appear to warrant legislative action. They will, however, not be forgotten.

Another question is ever present which requires further research, namely, that of various strains in the same species of fungus. It is possible that different strains are concerned in the *Nectria* Canker and *Monilia* Brown Rot of Apples in America and in Europe and hence different results show in the two continents. It is possible also that the notorious *Stereum purpureum*, the cause of Silver Leaf in Europe, is not absolutely identical on both sides of the Atlantic and hence does not attack Plums in the United States and Canada as it does in Britain.

The Ministry is indebted to Professors H. H. Whetzel and M. F. Barrus of Cornell University for the photographs of Fire Blight and Black Knot of Plum and to Professor C. R. Orton for obtaining sanction from the Pennsylvania Chestnut Tree Blight Commission to use the photographs of Chestnut Blight accompanying this article.

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918. SEASON 1921.

THE second year of the operation of the Horse Breeding Act, 1918, under which it is illegal to travel a stallion for service or to exhibit it on premises not in the occupation of its owner with a view to its use for service unless the horse is licensed, is now completed, and the Ministry is in a position to furnish information as to the results of the operation of the Act in England and Wales during the past season. The number of stallions licensed was 3,816 and 244 were refused (18 of the latter on appeal). Last year the comparative numbers were 3,749 and 404 respectively, and it will be noted, therefore, that there has been a small increase in the number of licensed stallions this season and a considerable decrease in the number of refusals. Of the 3,816 licensed stallions 3,418 were pedigree animals and the remaining 398 were horses that were not entered or accepted for entry in any recognised stud book.

As will be seen from the Table annexed, 2,316 or 68 per cent. of the pedigree stallions licensed, were of the Shire Breed, good evidence of the popularity of this breed.

The following diseases or defects are prescribed in the Regulations of 1919 for England and Wales, made under the Act, as rendering a stallion unsuitable for the service of mares, namely:—Cataract, roaring, whistling, ringbone (high or low), sidebone, bone-spavin, navicular disease, shivering, stringhalt, and defective genital organs. The Table hereunder gives the number of each breed or type of stallion in respect of which licences have been refused and the diseases or defects with which the animals were affected. It will be noted that the most common diseases on account of which stallions were refused licences were whistling, roaring and sidebone, which account for 124 refusals out of a total of 244.

Appeals were lodged against refusals of licences in 44 cases and 26 of them were successful.

During the travelling season the Ministry's Inspectors were instructed to stop stallions they met on the road and to require the production of the licences, and it is satisfactory to be able to report that in only comparatively few instances were the stallions unaccompanied by their licences and only in seven instances were the stallions unlicensed. Failure to comply with the Regu-

TABLE I.

	HEAVY.					LIGHT.								PONY AND COB.									
	Breeds.					Breeds.								Breeds.									
Pedigree Stallions, *i.e.*, Stallions entered or accepted for entry in the recognised Stud Book of their Breed.	Shire.	Clydesdale.	Suffolk.	Percheron.		Hackney.	Thoroughbred.	Arab	Cleveland Bay.	Hunter.	Welsh Roadster.	Yorkshire Coach.	—	Welsh.	Fell.	Polo.	Dales.	Shetland.	Highland.	New Forest.	Welsh Cob.	—	Totals.
Licensed	2,316	266	235	38	—	191	161	21	7	5	3	3	—	31	22	19	17	9	3	1	70	—	3,418
Refused	167	15	17	3	—	10	7	—	—	—	1	—	—	—	—	—	—	—	—	—	2	—	222
Applications	2,483	281	252	41	—	201	168	21	7	5	4	3	—	31	22	19	17	9	3	1	72	—	3,640
	Types.					Types.								Types.									
Non-Pedigree Stallions, *i.e.*, Stallions not entered or accepted for entry in a recognised Stud Book.	Shire.	Clydesdale.	Suffolk.	Percheron.	Others.	Hackney.	Thoroughbred.	Arab.	Cleveland Bay.	Hunter.	Welsh Roadster.	Yorkshire Coach.	Others.	Welsh.	Fell.	Polo.	Dales.	Shetland.	Highland.	New Forest.	Welsh Cob.	Others.	Totals.
Licensed	147	14	2	1	80	54	2	2	—	5	1	1	24	2	1	2	10	—	—	—	32	18	398
Refused	15	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	1	22
Applications	162	17	2	1	81	54	2	2	—	5	1	1	24	2	1	2	11	—	—	—	33	19	420
Total Licensed	2,463	280	237	39	80	245	163	23	7	10	4	4	24	33	23	21	27	9	3	1	102	18	3,816
Total Refused	182	18	17	3	1	10	7	—	—	—	1	—	—	—	—	—	1	—	—	—	3	1	244
Total Applications ...	2,645	298	254	42	81	255	170	23	7	10	5	4	24	33	23	21	28	9	3	1	105	19	4,060

TABLE II.

Breed.	No. examined.	No. refused.	Percentage of refusals.	Reasons for Refusal: Whistling.	Roaring.	Side-bone.	Cataract.	Ring-bone.	Bone Spavin.	Shivering	Defective Genital Organs.	String-halt.	General Unsuitability.
Pedigree.													
Shire	2,483	167	6·73	52	40	32	18	6	5	7	1	—	6
Clydesdale ...	281	15	5·34	2	4	4	—	1	1	—	1	1	1
Suffolk	252	17	6·74	5	1	3	—	4	1	—	2	1	—
Percheron ...	41	3	7·32	2	—	—	—	—	—	—	—	1	—
Hackney	201	10	4·97	3	—	—	2	—	1	—	2	2	—
Thoroughbred ...	168	7	4·16	2	—	—	2	1	1	—	—	1	—
W. Roadster ...	4	1	25·00	—	—	—	1	—	—	—	—	—	—
W. Cob	72	2	2·77	1	—	1	—	—	—	—	—	—	—
Non-Pedigree.													
Heavy	263	19	7·22	1	3	6	3	3	3	—	—	—	—
Pony and Cob ...	68	3	4·41	1	—	1	—	—	1	—	—	—	—
Totals of Refusals ...	—	244	—	69	48	47	26	15	13	7	6	6	7

lations was also reported to the Ministry by the Police, who took proceedings for offences under the Act and in the great majority of cases convictions were obtained.

It is evident from the working of the Act during the second year of its operation that the necessity of having stallions licensed and of the licences being carried by the grooms when leading the stallions is now generally recognised, and the plea of ignorance, which was so common last year, was but seldom made during the past season.

It is of course premature at present to expect any good results to be noticeable from the operation of the Horse Breeding Act, but the Ministry has evidence that owners of licensed stallions no longer suffer as they used to do from the competition of the unsound stallion whose chief qualification, in the estimation of the careless and ignorant farmer, was the cheap fee at which it travelled, and the clearance of such stallions from the road must in course of time secure improvement in the Horse Breeding Industry.

It should be added that licences issued for the licensing year 1921 will expire on the 31st October, 1921, and should be returned to the Ministry as soon as possible after that date. Failure to comply with this requirement renders an owner liable to a fine not exceeding £5. From the 1st November, 1921, applications may be made for licences for the year ending 31st October, 1922, and as the Ministry cannot undertake to examine stallions at short notice, owners are advised to send in their applications at the earliest possible date. If many defer doing so till the service season approaches it will not be possible to deal with all applications before the season actually commences.

It should also be noted by owners of pony stallions, that an alteration has been made in the Regulations, whereby the licence fee will henceforth be one guinea, no reduction being made as hitherto in favour of pedigree stallions not exceeding 15 hands in height.

NOTES ON MANURES FOR OCTOBER.

E. J. RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Effect of the Drought on Fertilisers in the Soil.—In a season so exceptional as the one now drawing to a close there has necessarily been much experience with fertilisers that was wholly unexpected. In many cases land was well manured for roots, but no roots grew; elsewhere much fertiliser has been put on grass land with no effect. The question therefore arises, to what extent can fertilisers added to the soil in seasons such as the present be relied upon for next year's crops?

There is abundant evidence to show that *Potash* and *Phosphates* remain unchanged during a dry season, and they will therefore come in perfectly well for succeeding crops in the rotation: no loss need be feared. The fertiliser added has not been wasted, but is simply lying where it can be taken up by the plant. This holds true of sulphate of potash, muriate of potash, kainit, superphosphate, basic slag, mineral phosphates and bone manures.

Nitrogenous manures, however, are liable to behave differently. Some of them have probably been taken up by the crop, and, if so, they cannot of course be expected to act in the soil again. Cases have come to the writer's notice where a quick-acting nitrate was taken up by the grass crop, as shown by the dark green colour and additional growth of the herbage; while the slower acting nitrolim was not taken up, but lay on the soil unchanged. Nitrogenous manures left thus unabsorbed will probably change rapidly to nitrates when the soil becomes sufficiently wet, and they may then be taken by a crop, or washed out of the soil; but they are not likely to be left unchanged in the soil. So much depends on local conditions that it is difficult to lay down general rules; the following, however, will probably not be far wrong:—

1. On grass land intended for hay the nitrogenous manure will probably remain effective for the coming season. It has happened after a great drought that heavy rain was followed by an unusually copious growth of grass.

2. On arable land intended for winter corn the nitrogenous manure may also remain effective, especially in view of the fact that work is well forward and sowing is likely to be early.

3. On arable land intended for roots or spring corn, on the other hand, the nitrogenous manure may suffer considerable loss. It is likely to change into nitrates rapidly if it is not already in that form, and then it is liable to be washed out of the soil. If the winter should be wet there will be just as much need for nitrogenous manure next spring as if this season had been an ordinary one. This statement, however, does not apply to potash and phosphates, which are not liable to be washed out, except perhaps from very light sandy soils under heavy rainfall.

The Quantity of Fertiliser to use on the Farm.—In endeavouring to work out the fertiliser requirements of the farm it is safe to assume :—

1. That sufficient of the manure applied for roots and potatoes will remain over for winter corn, so that nothing need be given unless the winter turns out very wet, when a spring dressing of sulphate of ammonia or nitrate of soda will be required;

2. That winter corn following a previous corn crop is not likely to want much fertiliser where it has been possible to plough or broadshare the stubbles and so let in the sunshine and the air;

3. That spring corn will want its usual fertiliser treatment unless the winter is very dry;

4. That roots will require the usual quantity of fertiliser.

Treatment of Clover.—At the present time the condition of the young clover is very unsatisfactory, and many leys are already lost. A certain amount of mending is possible, and trefoil may be sown. Where the young plant still survives and there has been sufficient rain to ensure that it will grow it may be helped on heavy soils by a dressing of basic slag, about 4 cwt. to the acre: on light soils kainit at the rate of 3 cwt. or 4 cwt. to the acre may be used instead. No fertiliser treatment will help, however, when the plant is too far gone, or where the soil still remains dry. If it is decided to continue the old leys for another year this manurial treatment should certainly be given. If it becomes necessary to plough them up and sow barley, the phosphate or potash will serve a very useful purpose for this crop, and probably be all that is necessary.

Chalk or Lime on the Land.—At Rothamsted we probably receive more letters from farmers about lime, limestone or chalk

than about any other single subject. It is evident from their inquiries and from our own observation in the country that liming is still one of the farmers' big problems. It is very desirable that new sources of supply should be opened out and that old limestone or chalk quarries and limekilns should be examined with a view to restarting. There is often a fear that the local limestone is not good agricultural lime. It may not be the best obtainable, but it may be the cheapest because of the saving in transport charges. County authorities, Farm Institutes and Farmers' Clubs who are desirous of making some useful field trials could very well explore the local supplies of limestone and lay out the following test:—

Plot 1.—2 tons per acre local limestone.
,, 2.—2 tons per acre ground limestone of recognised good quality.
,, 3.—10 to 15 cwt. per acre local burnt lime.

The information would be valuable, enabling a farmer to decide whether he can use local lime or limestone, or whether it will be more profitable to him to go further afield and purchase a recognised good quality limestone at a higher price.

Neutral Sulphate of Ammonia and Acid Sulphate of Ammonia.—A correspondent inquires what is the difference between these two fertilisers and whether one has any advantage over the other. The ordinary pre-war and wartime sulphate of ammonia was always slightly acid, but in recent years a modification in the method of manufacture has been introduced which gives a product having an acidity which is so slight as to be negligible; it is always less than 0.02 per cent. and sometimes only about 0.01 per cent. This is called "neutral" sulphate of ammonia, and it has several advantages over the ordinary "acid" product because:—

a. It is often in smaller crystals and can therefore be more evenly distributed by the machine.

b. It does not cake and therefore does not require to be broken up before use.

c. It is not wet.

These advantages would ensure that a farmer would always take the "neutral" product if he could obtain it. The process, however, is not yet widely adopted by gas works and other makers, and until it becomes more general many farmers must perforce use the old "acid" material.

Composition of Purchased Manures.—A correspondent asks for the composition of the ordinary purchased manures. The information is given in the table below:—

Percentage Composition of Ordinary Purchased Manures.

	Nitrogen (N).	*Phosphoric acid* (P_2O_5).	Equal to Phosphate $Ca_3(PO_4)_2$.	*Potash.* (K_2O).
Nitrate of ammonia	34.8			
Nitrate of soda	15·5			
Nitrate of lime	13			
Sulphate of ammonia	20–20·4			
Nitrolim	14.5–15			
Superphosphate (soluble only)		11·5 13·6 16·0	26 30 35	
Basic slag		19·1 15·5 9·1	42 34 20	
Raw bones	5	22	48	
Bone meal	3·5–4·5	20–25	43–55	
,, ,, (a usual analysis) ...	3·75	20·6	45	
Steamed bone flour	1–2	25–32	55–69	
Dissolved bones	2–3	15–16	33–35	
Sulphate of potash				48·5
Muriate of potash (pre-war usual quality)				45
,, ,, (now obtainable) ...				50–60
Kainit (pre-war, usual quality)				12·5
Sylvinite (French Kainit) ...				14–16
Rape cake	5	2	4	1
Ashpit refuse, variable, about ...	0·5	0·5	1	2
Sewage sludge, variable, about ...	1	1	2	
,, ,, (activated) ...	6	4	9	
Fish meal	8–10	4.5–9	10–20	1
Phosphate guano	5–8	14–18	30–40	

NOTES ON FEEDING STUFFS FOR OCTOBER.

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Ministry of Agriculture and Fisheries.

IN making up a ration for fattening animals two considerations are necessary: (1) an adequate well-balanced ration for the purpose in view must be given, and (2) the materials used must be so adjusted as to give a carcass to meet the butcher's approval. Not sufficient attention is generally paid to the necessity of producing a carcass suitable for slaughter, the chief fault being the production of unsuitable fat. It may, therefore, be of advantage to discuss briefly the type of carcass required by the butcher.

In the case of cattle the natural tendency of the beast is to produce a hard, tallowy fat; in the case of the pig, on the other hand, the natural tendency is to produce a fat of oily consistency. The objects of the feeder, therefore, are different in these two cases. In feeding pigs, foods should be given which tend to harden the fat; in fattening cattle, foods having a tendency to soften the fat should be given. Experiments have shown that the nature of the fat in the animal can be altered to a considerable extent by the nature of the food fed. In an experiment with fattening lambs, in which, in addition to the basal ration, maize and sunflower seed cake were fed to the one lot, and crushed peas and wheat husks to the other, the sunflower seed cake and maize lot produced an excellent quality of meat with soft fat, whereas the crushed peas lot gave a very poor carcass, the fat being hard and crumbly.

Summing up the results of experiments of this nature, and also of practical experience, it is possible to say that both pigs and cattle yield harder bacon or fat when they are fed on grains rich in starch and poor in oil, such as rye, barley, peas, beans and lentils. The same effect is produced by the use of potatoes, mangolds, and palm nut and coconut cakes. A soft and rather oily fat is obtained from the use of sunflower seed cake, linseed cake, rape cake, rye, peas, maize, wheat bran, oats, and fish and meat meals rich in fat. In making up a ration for bacon pigs or for cattle these points should be taken into consideration where the feeder wishes to get a good market for his produce.

One other point arises: in feeding all animals on foods containing oil or fat care should be taken, if the best results are wished

NAME.	Cost.		Cost per Ton.		Manurial Value per Ton.		Cost of Food Value per Ton.		Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£	s.	£	s.	£	s.		s.	d.
Barley, English Feeding	50/0	400	14	0	1	6	12	14	71	3/7	1·92
" Canadian " -	47/-	400	13	3	1	6	11	17	71	3/4	1·78
Oats, English White " -	38/-	336	12	13	1	9	11	4	59·5	3/9	2·01
" " Grey & Black	34/-	336	11	7	1	9	9	18	59·5	3/4	1·78
" Canadian - -	35/6	320	12	8	1	9	10	19	59·5	3/8	1·96
" Argentine - -	31/3	320	10	19	1	9	9	10	59·5	3/2	1·70
Maize, Argentine -	41/6	480	9	14	1	5	8	9	81	2/1	1·12
Beans, English winter -	55/-	532	11	12	3	1	8	11	66	2/7	1·38
" Rangoon - -	16/6	112	16	10	3	1	13	9	66	4/1	2·19
Peas, English blue -	110/-	504	24	9	2	13	21	16	69	6/4	3·39
" " dun -	69/-	504	15	7	2	13	12	14	69	3/8	1·96
" " maple -	98/-	504	21	16	2	13	19	3	69	5/7	2·99
Rye, English - -	56/-	480	13	1	1	8	11	13	72	3/3	1·74
Millers' offals—Bran -	—	—	10	5	2	10	7	15	45	3/5	1·83
" " Coarse middlings	—	—	13	5	2	10	10	15	64	3/4	1·78
Oat Husks* - - -	—	—	3	15*	—		—		—	—	—
Rice Bran* - - -	—	—	9	10*	—		—		—	—	—
Barley meal - - -	—	—	16	10	1	6	15	4	71	4/3	2·28
Maize " - - -	—	—	11	10	1	5	10	5	81	2/6	1·34
Fish " - - -	—	—	19	10	7	12	11	18	53	4/6	2·41
Linseed - - -	—	—	23	0	2	16	20	4	119	3/5	1·83
" Cake, English -	—	—	16	5	3	12	12	13	74	3/5	1·83
Cotton seed " " -	—	—	11	2	3	5	7	17	42	3/9	2·01
" " Egyptian	—	—	11	0	3	5	7	15	42	3/8	1·96
" " decorticated	—	—	15	10*	5	6	10	4	71	2/10	1·52
" Meal, decorticated	—	—	14	15	5	6	9	9	71	2/8	1·43
Coconut cake - -	—	—	14	12	3	0	11	12	79	2/11	1·56
Groundnut cake - -	—	—	12	5	3	9	8	16	57	3/	1·65
Palm kernel cake - -	—	—	12	10	2	1	10	9	75	2/9	1·47
Brewers' grains, dried, ale	—	—	10	0	2	7	7	13	49	3/1	1·65
" " " porter	—	—	9	0	2	7	6	13	49	2/9	1·47
" " wet, ale	—	—	1	17	0	12	1	5	15	1/8	0·89
" " wet, porter	—	—	1	10	0	12	0	18	15	1/2	0·62
Malt culms - - -	—	—	8	0	3	6	4	14	43	2/2	1·16
Potatoes † - - -	—	—	2	5	0	8	1	17	18	2/1	1·12
Swedes † - - -	—	—	1	2	0	5	0	17	7	2/1	1·12
Mangolds † - - -	—	—	0	18	0	6	0	12	6	2/1	1·12
Vetch and Oat Silage †	—	—	2	4	0	15	1	9	14	2/1	1·12

* Prices at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

for, to restrict the amount of oil fed in the ration to about 1 lb. per thousand pounds body weight in the case of cattle, and up to, but not exceeding, 2 lb. per thousand pounds body weight in the case of pigs.

In next month's notes it is proposed to deal with winter rations for pigs, dairy cattle, fattening cattle and horses, suitable for farms on which a shortage of roots has been experienced this year. The writer would welcome any suggestions from readers who have already overcome this difficulty.

Rabies.—No outbreak of Rabies has occurred since the issue of the September *Journal.*

Salisbury and Southampton.—A considerable modification of the area under restrictions in connection with the outbreaks in this district was made as from 31st August, the eastern portion of Hampshire within the district being excluded from that date. The inner controlled areas are still maintained around Salisbury and Southampton.

Foot-and-Mouth Disease.—There has been no development of Foot-and-Mouth Disease in the Stoke-on-Trent district, nor has the disease been confirmed in any other part of Great Britain. All general restrictions in connection with the outbreaks on 10th and 11th August were withdrawn as from 8th September.

Leaflets issued by the Ministry.—Since the date of the last list given on page 576 of the September issue of the *Journal*, two new leaflets have been published:—

No. 373.—Mosaic Disease of Potatoes.
„ 379.—Nauru Phosphate.

The following leaflets have been revised and brought up to date:—

No. 96.—Milk Fever or Parturient Apoplexy.
„ 187.—The Selection and Milking of Dairy Cows.
„ 192.—Farm Buttermaking.
„ 309.—Suggestions to Allotment Holders for Autumn Treatment of Land.
„ 337.—Cheddar Cheese.
„ 353.—Winter Oats.

The following leaflet has been amended:—

No. 15.—The Apple Blossom Weevil.

The following leaflets have been withdrawn:—

No. 260.—Statistics of Agricultural Co-operative Credit Societies in England and Wales.
F.P. 47.—The Testing of Seeds Order, 1918.

Seed Potatoes from Scotland and Ireland.—The Ministry desires to remind persons in England and Wales who propose to obtain "seed" potatoes direct from Scotland during the coming season that the regulations governing such importations which were in force last year are still in operation; and further, that since 1st September, 1921, similar regulations apply to "seed"

potatoes imported from Ireland. These regulations are, briefly, that all "seed" potatoes imported from Scotland or Ireland must be accompanied by one or other of two prescribed declarations, and any person receiving from either of these countries any "seed" potatoes which are not accompanied by a declaration must report the fact to the Ministry within 7 days of receipt of the potatoes and refrain from moving or disposing of the potatoes until he has obtained permission from the Ministry. The declaration required is :—

(*a*) In the case of "seed" potatoes of varieties approved as immune from Wart Disease certified whilst growing by the Scottish Board or by the Irish Department of Agriculture :—a declaration by the consignor correctly stating the serial number of the relative certificate of purity ;

(*b*) In the case of all other "seed" potatoes :—a declaration by the consignor correctly stating the reference number of the certificate issued not more than 9 months previously by the Scottish Board or by the Irish Department of Agriculture, certifying, in the case of Scotland, that Wart Disease has not occurred on, nor within one mile of the land on which the potatoes were grown, or, in the case of Ireland, that Wart Disease has not occurred in the locality in which the potatoes were grown.*

Importation of Plants, Bulbs, &c.—Importers of plants, bulbs, &c., from countries outside the United Kingdom and the Channel Islands should be aware of the requirements of the Order of the Ministry which comes into operation on 1st October next.* They should also bring them to the early notice of those abroad who send them plants, bulbs, &c. The Order applies to all living plants with a persistent woody stem above ground, and parts of the same used for propagation except seeds ; all potatoes ; all tubers, bulbs, rhizomes, corms, and hop stocks for planting ; seeds of onions and leeks for sowing ; and gooseberries, The Order requires that every consignment of these plants, or parts of them, destined for England and Wales, shall be inspected in the country of origin and certified by a duly authorised official of that country not more than 30 days prior to shipment as being generally healthy and free from the pests scheduled in the Order. In the case of potatoes, other than new potatoes, the certificate must also declare that Wart Disease has not occurred on the place where the potatoes were grown, nor within 500 yards thereof (approximatly ½ kilometre). New potatoes, that is potatoes landed in this country on or before 31st July in the year in which they have been lifted, must be accompanied by a declaration in writing to the effect that they have been lifted in the same year.

When sending a consignment, the consignor should despatch the original certificate with information as to the number of packages, nature of plants or parts thereof, name of vessel, port of entry and approximate date of arrival, to the Horticulture Division of the Ministry of Agriculture, 4, Whitehall Place, London, S.W. 1. He should affix a copy of the certificate to each package of the consignment, which must also be clearly labelled as to the nature of the plants or parts thereof in it. This label may be a part of the copy certificate.

* Copies of the Wart Disease of Potatoes (Imported Scottish Seed Potatoes) Order of 1920, the Wart Disease of Potatoes (Imported Irish Seed Potatoes) Order of 1921, price 1d. net each, and the Destructive Insects and Pests Order of 1921 (S.R. and O., 1921, No. 931), price 2d. net, may be purchased through any bookseller or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

If a consignment or package arriving in England and Wales is so certified and labelled, it will be admitted without delay. If, however, it is not accompanied by the certificate it will be detained on arrival at the port of entry and will not be delivered to the consignee until it has been examined and passed by an Inspector of the Ministry. Should any consignment be found on arrival to be diseased within the meaning of the Order, it will only be delivered to the consignee after disinfection or other necessary treatment has been carried out at the expense of the importer. If such disinfection or treatment is not carried out, the consignment must either be destroyed or returned to the country of export by the importer. It will be observed, therefore, that failure to comply with the requirements of the Order will necessitate delay in delivery, and may lead to refusal of entry.

Importation of Rhododendrons.—Some misunderstanding appears to exist as to the effect of the new Orders issued by the Ministry, dealing with the importation and sale of plants, &c. (The Destructive Insects and Pests Order of 1921, and The Sale of Diseased Plants Order of 1921). Nurserymen point out that the Rhododendron Fly, a pest serious on Rhododendrons in certain countries, is scheduled under the Sale of Diseased Plants Order, and that therefore they are prevented from selling in this country plants which are substantially attacked by this pest. This is correct, but the conclusion has been drawn that, since the pest is not scheduled under the Destructive Insects and Pests Order of 1921, which relates to imported plants, Rhododendrons badly attacked by the Fly will be allowed to enter the country freely. Such, however, is not the case.

A careful reading of the Destructive Insects and Pests Order of 1921 will show that Rhododendrons sent to this country must be accompanied by a Health Certificate, signed by an official of the country of origin, to the effect that the plants are perfectly free from the pests mentioned in the Order, and also that they are "healthy." In paragraph 5 of the Third Schedule of the Order, it is laid down that plants will not be deemed to be "healthy" if attacked by any of the pests mentioned in the Sale of Diseased Plants Order of 1921. It is therefore clear that the Health Certificate accompanying imported plants goes very much farther than a Certificate of Freedom from the specific pests mentioned in the Second Schedule to the Destructive Insects and Pests Order, since it must also declare that the plants are healthy in general, and particularly with regard to the pests mentioned in the Sale of Diseased Plants Order.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 8.

NOVEMBER, 1921.

NOTES FOR THE MONTH.

Concilation Committees in Agriculture.

TOWARDS the end of October, the position as regards the formation of Conciliation Committees was that, although in two or three areas the preliminary meetings of the Interim Conciliation Committees had not been held, initial arrangements had been completed in all outstanding cases and the whole of England and Wales is now covered by Interim or Permanent Conciliation Committees set up under the Corn Production Acts (Repeal) Act. The total number of these Committees in October was 45, but it is anticipated that some of the present areas will decide eventually on further sub-division.

It will be remembered that these Committees, which are voluntary bodies composed of representatives of local employers and workers in agriculture, are being set up to deal with wages, hours and conditions of employment. It was hoped that each Committee would recommend rates of wages to operate immediately from 1st October, the date of the abolition of the Wages Board. With this object in mind several Committees were able to arrive at temporary agreements, which in some cases are still operative, and no doubt these Committees will in due course see their way to reach agreements of a more permanent nature. These temporary agreements, which will expire before the end of October, were made in Cheshire, Kent, Isle of Ely, Hampshire, Lancashire, Leicestershire and Rutland, Warwickshire, and the North Riding of Yorkshire.

In 11 areas (Cambridgeshire, Cornwall, Cumberland and Westmorland, Devonshire, Durham, Hertfordshire, Norfolk, Shropshire, Staffordshire, Denbigh and Flint, and the East Riding of Yorkshire) agreed recommendations for rates of wages have been made to apply during November and Decem-

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ber, and in some cases up to January and February, 1922. In the remaining 26 areas negotiations have reached various stages. Frequently area and constitution questions have delayed the discussion of wages, which has been deferred to later meetings. The suggestions of each side have in some cases necessitated further reference to the Executives of the Representative bodies and have thus resulted in delaying decisions. In certain of the few areas in which there has been any serious difficulty, steps have already been taken for the early resumption of negotiations between the two sides.

Although the representatives of employers are in many areas at present opposed to agreed rates being confirmed by the Ministry, they have supported the principle of confirmation in Cambridgeshire, Surrey, and Brecon and Radnor. The Cambridgeshire Committee have already submitted their agreed rates to the Ministry for confirmation. When rates of wages agreed by a Conciliation Committee have been confirmed and advertised by the Ministry, such rates become an implied term of every contract of employment for the particular class of worker concerned.

Agricultural Research and Education: The Government's Policy.

IN a speech recently delivered in Northamptonshire, on the occasion of the opening of the new Farm Institute provided by the Northamptonshire County Council at Moulton Grounds Farm, the Minister of Agriculture and Fisheries outlined the Government's policy with regard to agricultural reseach and education.

Sir Arthur Griffith-Boscawen said he was much interested in the Farm Institute movement, because he was certain it was going to do great things for agriculture. The Government was often criticised for want of policy as regards agriculture, or for having too many policies, or too many contradictory policies, or for changing policy. He had come to the conclusion that they could help agriculture very little by legislation. They could do very often a great deal of harm, and they had got to walk very warily if they were going to do much good, but he was sure that by sound administration, and by promoting the application of science to the farm, by giving bigger grants and assisting in the establishment of places where research and education could be carried out, the Government would be helping British agriculture to success in the future.

The future of British agriculture depended upon knowledge, and he hoped the policy they had devised would be immutable, more like the laws of the Medes and Persians than some laws they had passed lately. He hoped their policy in the future would be one of consistent promotion of agricultural education and research with a view to the greater application of science to the farm.

In that policy there were certain stages. Research must come first. The research institution was the primary body. They had got to establish the principles upon which progress in a farm would depend. They had not to be in too great a hurry. In the past, money had been wasted on policies which had proved faulty in the long run. They had to establish their principles and make sure of their facts, and then apply them. The work that was being done at such places as Rothamsted on questions relating to the soil and to manures; at Cambridge in plant breeding, where Professor Biffen had produced some new wonderful wheats which had been so successful in many parts of the country, and in animal nutrition; at Reading, where the principles of dairying were being investigated and admirable results secured; and at Bristol, where horticulture was being scientifically examined—all those works, he was sure, would be for the permanent advantage of British agriculture.

When they had established their principles and facts and had arrived at the latest and best and most economical processes, they had to make them known. That could be done in various ways. Many agricultural colleges were doing excellent work, but the college existed largely for the more well-to-do who could afford time and money to take a long course far away from their homes. What was wanted were places where the sons of working farmers could go for short courses near their homes, and go in the winter-time when there was not so much work on the farm, and where they could be brought into touch with the best scientific knowledge, which was constantly being added to, through the work of the research institutes.

The Farm Institute was not only for the farmer and smallholder; he hoped very much to see there in increasing numbers the sons and daughters of agricultural labourers. This would involve offering free places, scholarships and maintenance allowances. All these were purposes which had been specifically mentioned in the Act of Parliament recently passed (The Corn Production Acts (Repeal) Act, 1921), which established a fund of one million pounds for agricultural development. In the

summer, there would be short courses near their homes for daughters of farmers and farm workers, who would learn all about dairying, poultry rearing, the bottling of fruit, cooking and other subjects which would prove of the greatest advantage on the farm, so that the whole family would take an intelligent and practical interest in the work of the farm.

That was the idea of the Farm Institute, which it was hoped would become the centre of agricultural intelligence for the county: a place where every kind of help could be given, where farmers could go for advice, where soils could be tested, feeding stuffs and fertilisers analysed and their value ascertained, and where information could be given on the combating of pests and diseases. He felt sure the institutes would gradually obtain the confidence of farmers and become of the greatest value to those engaged in work on the land.

Although it was as long ago as 1908 that a Departmental Committee, presided over by Lord Reay, recommended that there should be a Farm Institute in every county, or group of two or three counties, the progress in this direction had been slow, so that only four institutes had been established when the War began. Since the War twelve more institute schemes had been projected, but only six of them had got under way when the economy axe fell, and the other six had to be abandoned temporarily.

When the Repeal of Part 1 of the Corn Production Act was passed and the Government was compelled by financial stress to abandon the guaranteed prices, they were able to save about £1,000,000 from the wreck, and that money was to be devoted to agricultural education and research. Out of that money he hoped to restart the six institute schemes that were abandoned, and also to set on foot five or six more. In that event there would be 24 or 25 Farm Institutes scattered about the country. The results to British agriculture could not be put down in black and white, but he felt certain they would be incalculable, and that every penny spent, whether by the Government or by enlightened County Councils like that of Northamptonshire, would be money well spent, and that it would bring in a handsome return.

The session which is just commencing will see Farm Institutes at work in the following counties:—Cheshire, Cumberland and Westmorland, Essex, Hampshire, Hertfordshire, Northamptonshire, Somersetshire, Staffordshire, Suffolk, Carnarvonshire, Denbighshire and Monmouth.

Full information as to the courses of instruction and other work which will be carried on at these institutes can be obtained on application to the County Agricultural Education Authorities.

International Labour Conference.

THE Third International Conference held in accordance with the Labour Clauses of the Peace Treaty assembled at Geneva on 25th October, 1921. This Conference, at which all the countries which were parties to the Peace Treaty (except the United States of America) are represented, is of special interest to agriculture owing to the fact that a number of items on the agenda relate to agricultural labour, viz. :—

Adaptation to agricultural labour of the Washington decisions concerning the regulation of the hours of work.

Adaptation to agricultural labour of the Washington decisions concerning :—

(a) Measures for the prevention of or providing against unemployment;

(b) Protection of women and children.

Special measures for the protection of agricultural workers :—

(a) Technical agricultural education;

(b) Living-in conditions of agricultural workers;

(c) Guarantee of the rights of association and combination;

(d) Protection against accident, sickness, invalidity and old age.

Each participating country is represented at the Conference by two Government Delegates, one Delegate representing the employers and one Delegate representing the workpeople.

In the case of Great Britain the Government Delegates are Sir Montague Barlow, M.P., Parliamentary Secretary to the Ministry of Labour, and Sir Daniel Hall, K.C.B., F.R.S., Chief Scientific Adviser to the Ministry of Agriculture; the Employers' Delegate is General A. C. Bayley, National Confederation of Employers' Organisations; and the Delegate representing the workpeople is Mr. E. L. Poulton, O.B.E., J.P., Vice-Chairman of the General Council of the Trade Union Congress. The Employers' Delegate will be assisted as regards agricultural questions by Mr. James Donaldson, Vice-President of the National Farmers' Union, and by Mr. Alexander Batchelor, Vice-President of the Scottish Farmers' Union; the Workers' Dele-

gate will be assisted by Mr. R. B. Walker, of the National Union of Agricultural Labourers, Mr. John Beard, of the Workers' Union, and Mr. J. F. Duncan, of the Scottish Farm Servants' Union; while the Government Delegates will be accompanied by Mr. R. J. Thompson, of the Ministry of Agriculture, and Mr. H. M. Conacher, of the Board of Agriculture for Scotland.

* * * * * *

The Monthly Agricultural Index Number.

THE Monthly Agricultural Index Number* of the prices of agricultural produce prepared by the Ministry of Agriculture shows that the prices at which farm products were sold in September were on the average 105 per cent. above the average rates in the three years 1911-13. This represents a fall of 11 points as compared with the preceding month when the average stood at 116 per cent. above the 1911-13 level. The following table shows the figures for each month since the beginning of 1919:—

Month.	Increase per cent. on the average of the years 1911-13. 1919.	1920.	1921.
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	105
October	166	191	—
November	182	197	—
December	207	194	—

Wheat and oats fell during the past month, but barley showed a seasonal rise due to a larger proportion of malting barley being put on the market. All descriptions of live stock showed a decline during the month, and this was also the case with butter, cheese, poultry and eggs. On the other hand higher prices were obtained for milk, as is customary in the autumn. Potatoes were cheaper. On the whole, taking one commodity with another farmers now appear to be receiving a little more than double pre-war prices. Among the commodities purchased by farmers, maize and milling offals are distinctly cheaper, while oil cakes and some other feeding stuffs show a small decline.

* An explanatory note on the Agricultural Index Number appeared in the issue of this *Journal* for October last, p 578.

Fertilisers on the whole have not varied very much during the month.

* * * * * *

International Potato Conference.

IN the issue of this *Journal* for September reference was made to the forthcoming International Potato Conference. The Organising Committee have now practically completed their arrangements. Official delegates have been appointed by the Governments of Belgium, Denmark, France, Greece, Germany, Holland, Hungary, Portugal, Rumania, Spain, Switzerland, India, New South Wales, Queensland, and Western Australia. Most of the principal countries which are interested in potato growing will therefore be represented. The American Government has not seen its way, so far, to nominate representatives, but two papers by officers of the United States Department of Agriculture will be read at the meeting. The Conference will be held in the Royal Horticultural Society's Offices, Vincent Square, Westminster, commencing 16th November, and will be opened at 10.30 a.m. with an address by Sir A. D. Hall, K.C.B., F.R.S., Chief Scientific Adviser to the Ministry.

The Programme of papers is as follows:—

Wednesday, November 16th.

11.20–12.	Breeding, Selection and Development Work in the U.S.A.—Wm. Stuart, Department of Agriculture, Washington.
12 –12.45.	Breeding, Selection and Development Work in Britain.—F. J. Chittenden, Donald McKelvie and Wm. Robb.
3 – 3.30.	The Industrial and Commercial Uses of the Potato.—H. V. Taylor.
3.50– 4.20.	The Early Potato Industry.—J. M. Hannah.
4.40– 5.10.	Degeneration of Potatoes.—Dr. R. N. Salaman.

Thursday, November 17th.

4 – 4.40.	Wart Disease of Potatoes.—V. H. Blackman and Wm. B. Brierley.
5.30– 6.	Some Information on the Heredity of Wart Disease.—R. N. Salaman and J. W. Lesley.

Friday, November 18th.

10.30–11.	New Work on Leaf Curl in Holland.—H. M. Quanjer.
11 –11.45.	Recent Investigations on Potato Blight.–G. H. Pethybridge.
11.45–12.15.	New Work on Mosaic in Ireland.—P. A. Murphy.
12.15–12.30.	The Situation as regards Leaf Curl and Mosaic in Britain.—A. D. Cotton.

It will be seen that the papers cover a wide range of subjects of the greatest possible interest to all who are concerned in the growing of potatoes, and the discussions on the various papers

should provide information of considerable importance. During the progress of the Conference the Annual Show of the National Potato Society will be held in the Royal Horticultural Society's Hall, and visitors will have an opportunity of examining the great majority of British varieties of potatoes. A scientific exhibit is also being prepared showing the recent results of research into potato diseases and potato breeding.

* * * * * *

Tests of Drainage Machinery.

THE Ministry has arranged a public demonstration of drainage machinery to take place at Harmston, near Lincoln, on 7th and 8th November. The demonstration will form the conclusion of a series of tests of drainage machinery of many types which has been proceeding for a considerable time. Machinery will be at work for making field drains, clearing farm ditches, and clearing and grading subsidiary water-courses. The tests do not, however, extend to floating machinery used on main water-courses. Among the more novel devices shown will be the Nordby Ditch Digger, which has been specially imported from Norway; the Priestman Grab Ditcher specially designed, in consultation with the Ministry, to operate on narrow and soft banks; a large grab-line machine designed by Messrs. Ruston and Hornsby; force and lift pumps supplied by Messrs. Gwynnes; a mole plough designed for direct traction by Mr. F. B. Wells, of Welwyn; and two types of Revolt excavators. It is expected that other machines, including the Buckeye Tractor Ditcher,* the Fowler Scoop, and a mole plough of the usual design, will also be on the ground, and will afford an opportunity for comparison between established and newer methods. A number of tractors will be employed, including a Clayton and a Saunderson, with specially designed attachments for operating the Priestman machine, and it is hoped that an internal combustion cable set will also be at work.

A comprehensive report, including complete records of the performances of each machine, with special reference to cost, will be published in due course.

Harmston is within easy reach by rail of Lincoln and Grantham, and the trial ground at Aubourn Fen is a mile from Harmston Station.

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* See this *Journal*, July, 1921, p. 306.

AGRICULTURE BEHIND THE LINES IN FRANCE.

LIEUT.-COLONEL J. H. FORRESTER ADDIE, C.B.E.,
Late Colonel, Royal Welsh Fusiliers, and late Deputy Director of Agricultural Production, G.H.Q., France, and

CAPTAIN A. T. A. DOBSON,
Late Lieut.-Colonel, Hampshire Regiment, and late Assistant Director; Assistant Secretary, Ministry of Agriculture and Fisheries.

Part I.—Up to the End of the German Offensive in 1918.

PROBABLY few people, unless familiar with the actual operations of the Army in France, have any idea of the extent to which that Army was self-supporting and of the steps that were being taken, when the War happily terminated in November, 1918, to render food production a definite part of the Army's operations.

It has been frequently observed that for every man engaged in the actual operations of fighting, there are some three or four engaged on the lines of communication and at the bases in supplying the fighting man in the trenches with food, ammunition and equipment. The Army in France contained men of all tastes and all trades, and it is not to be wondered at therefore that, at the many bases and stations on the lines of communication, such as ammunition dumps, supply dumps and so forth, there were to be found men with an agricultural training, or at all events, with a sufficient inclination and knowledge to spend their off hours in recreation of an agricultural nature.

It was for this reason that from an early date the establishment of garden plots became a regular feature of the various Army establishments of a more or less stationary nature, from the base ports up to within a reasonable distance of the fighting line. Even in Divisional areas, namely, those within, say 10 miles of the front line, agricultural operations were also prosecuted, but the constant moving of units, from one part of the front to another, naturally deprived such operations of any very great stability.

These early operations were largely, if not entirely, carried out by the enterprise of individual units and of their Commanding Officers, who realised the necessity for keeping their troops

in good heart by supplying them with healthy and interesting occupation in the hours set aside for recreation.

It soon, however, became apparent to the Authorities at G.H.Q. that this movement was one which ought also to be encouraged from the food supply point of view, and ought not to be left solely to the more or less private enterprise of individual units. Moreover, within the zone in the more immediate neighbourhood of the fighting front, the Army Authorities were constantly receiving requests from the French Authorities for assistance in harvesting the various crops to be secured in areas from which civilians had had to be withdrawn or in areas where civilians found labour difficult to procure, owing to the inroads made by the War on the male population.

It was not, however, until the middle of 1917 that the whole aspect of the question of food production began to demand the serious attention of the Quartermaster-General's staff at General Headquarters.

The submarine campaign had begun to take its toll to a menacing extent, and it began to be evident that the more independent the British Army in France could become of food supplies from home, more particularly potatoes (which absorbed a great deal of tonnage), vegetables, hay and cereals, the better for all concerned. With the conditions existing in France, a plentiful supply of fresh green vegetables was an invaluable if not essential item in the diet of the fighting soldier.

The Quartermaster-General was not unmindful of the fact that the area known as the British Army Zone comprised some of the richest agricultural land in France. Moreover, no one could be blind to the great success which had attended the systematic agricultural operations, in the form of vegetable gardens, which had been carried out by the troops of the French Army.

The first steps to be taken, therefore, were to place the whole undertaking on a properly recognised footing. Up to that time units had obtained the necessary money for the purchase of seeds from the Expeditionary Force Canteens, who were repaid as soon as the crop had been harvested and taken over by the Director of Supplies, the unit being credited with the value.

New arrangements were now made. It was decided that all money required should be advanced from the Fund, which existed at G.H.Q., known as the By-Products Fund, and the only units which were entitled to an advance from this Fund were to be the five Armies, the Lines of Communication as a

Photo, Crown Copyright.] [*Imperial War Museum.*

FIG 1.—At work on an Army Farm.

Photo. Crown Copyright] [Imperial War Museum.

FIG. 2.—An old Communication Trench.

whole, and the G.H.Q. troops area. The headquarters of each of these Formations had to ascertain the demands from the units within the area of its command, and to incorporate them in one combined application to G.H.Q. All produce harvested as a result of the scheme was to be taken over by the Director of Supplies at a flat rate of 10 centimes per lb., and at the end of the year the loan from the By-Products Fund was, so far as possible, to be repaid.

At the same time, in order that the undertaking might be extended to all available units and, above all, might be properly supervised, steps were taken to obtain particulars of all officers serving in the Army in France who possessed agricultural qualifications.

The two photographs (Fig. 1 and 2) which accompany this article show work proceeding on an Army Form. In Fig. 2 it will be seen that opportunity has been taken to plant potatoes in the bottom of a disused communication trench.

Towards the end of 1917, however, progress was made in a new direction with a view to expanding the scope of the undertaking, and after discussion with the Home Authorities and certain inspections of suitable areas by Dr. F. Keeble, of the Ministry of Agriculture and Fisheries, it was decided by G.H.Q. to establish a Central Farm for the British Expeditionary Force as a whole, as well as lesser farms in each Army area. All these farms, as well as all the other minor agricultural undertakings already discussed, were to be placed under the control and direction of a Director of Agriculture at G.H.Q., with representatives with the larger formations of the British Expeditionary Force.

It was not intended, however, that these central farms, which were more especially designed for the production of potatoes and cereals on a large scale, were to take the place of, or in any way involve the doing away with of the vegetable gardens that already existed all over the British Army area.

The question of organisation consequent upon this decision became one of great urgency. Suitable officers for service under the Directorate had to be selected and large quantities of machinery for the preparation of the soil had to be assembled. Moreover, a suitable area had to be chosen and the necessary agreement drawn up with the French Authorities. The area ultimately selected was one of about 45,000 acres in the region of Roye, which had been the scene of earlier fighting, but was at that time between 30 and 40 miles behind the British Front.

It may be wondered why existing farms were not taken over for this purpose far behind the fighting front. It must be remembered, however, that time was short, the season far advanced if any ploughing and planting were to be done in time for the harvest of 1918, and the only course to adopt, which would not give rise to endless negotiations with private French owners, was to select, in consultation with the French Authorities, an area in the *Zone Interdite*, namely, the land from which French civilians had been evacuated and to which they could not return. No vexatious questions as to ownership arose as regards the cultivation of this area, as it was controlled by the French Military Authorities, so long as it remained closed to civilian inhabitants. Moreover, the French had lost so much territory that it would not have been wise to suggest taking over farms which were actually being farmed. Naturally with so many farmers dispossessed from the devastated area, the French wanted for their own cultivation all the land they could retain.

The early months of 1918 will certainly never be forgotten by those who were engaged in equipping the Directorate with staff, with special Labour Companies for the execution of the work of cultivation, in collecting suitable men as tractor drivers, and last but not least, in the supply of agricultural machinery. The energy and rapidity shown by the War Agricultural Committee in England in the supply and despatch to France of agricultural machinery was only equalled by the speed with which the Director-General of Transportation dealt with it, as it arrived at Havre and sent it up to the railhead in the vicinity of Roye.

The appointment of the Directorate of Agricultural Production was approved by the War Office early in January and Brig.-Gen. the Earl of Radnor, who was appointed Director, proceeded to France on the 2nd of that month. By the 2nd February, 1918, no fewer than 59 tractors, 74 rollers, 40 harrows, 50 cultivators and 33 cases of tractor ploughs were actually on the site at Roye, while a further 35 tractors, 30 rollers, 17 tractor ploughs and numerous cases of spares were at Havre waiting to be put on rail.

On the same date a tractor plough turned its first furrow.

The Headquarters of the Directorate were in the first instance located at Le Touquet as it was essential that, while the necessary staff was being collected and other preliminary arrangements made, close touch should be kept with the

General Headquarters at Montreuil, a few miles distant. As soon as the area to be cultivated had been selected, the Headquarters of the Directorate were moved to Blangy Tronville, a little village west of Amiens lying just off the main Amiens-Peronne road.

Here the offices of the Directorate were within a few miles of the centre of operations and it was possible to keep close watch over, not only the arrival of stores, but almost more important, the assembling of tractors and the training as tractor drivers of men who were arriving from all parts of the Army area, as likely candidates for instruction. The provision of both skilled and unskilled labour presented a very difficult proposition. On every side there was the same story—the shortage of labour. The British Labour Corps which provided men for all purposes other than fighting in the trenches, were greatly below strength, and agricultural operations at that stage had to compete in the limited labour market with urgent services more directly connected with the military operations.

The Quartermaster-General in France in 1918, however, attached great importance to the success of the movement, and the strong personal interest which he took in the work materially helped to smooth away these difficulties.

As already stated, time was the greatest enemy to the undertaking. Every day lost meant a reduction in the number of acres ultimately to be put under the plough. As the result, however, of various Conferences at G.H.Q., six Agricultural Companies, formed according to a special establishment, composed of 1 officer and 169 other ranks, were promised by the Adjutant-General, as well as one British Labour Company, which was equivalent in strength to three Agricultural Companies. It was thus contemplated that there would be one Agricultural Company or its equivalent for each of the 9 blocks of about 5,000 acres into which the whole area was to be divided.

To obtain sanction for these companies was one thing, but to effect their assembling from all parts of the British Army area was another; and by the 27th January, 1918, only 50 men of the first Company had arrived, and even some of these were specially trained men sent out from England.

The task of manipulating the 200 tractors which were considered necessary for the cultivation of the whole area was entrusted to three specially formed Auxiliary (Petrol) Companies, Army Service Corps (Agricultural). The strength of

these Companies was 5 officers and 180 other ranks, divisible into three Sections, each of which had sufficient personnel to deal with 20 tractors. Thus each block of 5,000 acres was ultimately intended to be cultivated by means of one Agricultural Company, and one Section of the Auxiliary (Petrol) Company, with 20 tractors.

The position as regards the Petrol Companies was rather more hopeful, in that a large number of the personnel was supplied from unfit men in England, one complete company arriving by the 26th February. Practically all the personnel, however, had to be trained in a specially created school for tractor driving, but by the 8th March no fewer than 80 men were passed through the school with their training completed.

It is unnecessary at this point to present in greater detail the organisation designed for administering this large area. Suffice to say, however, that work went steadily forward from the 2nd February up to the 21st March.

On the first-mentioned date 6 acres were ploughed and on the last-mentioned date 203 acres were ploughed. The record acreage for one day was on the 17th March, when 300 acres were ploughed. By the 21st March, the ploughing of just under 5,000 acres had been completed.

The area selected was a suitable one in every way. It was advantageously situated. It was well traversed by roads and intersected by railways, one of which was the main line of supply to the British Army on that section of front. The soil varied in character from a light easy-working loam to a stiff clay. There was, however, a chalk subsoil and experience showed that the greater part of the land would work easily and well and excellent crops were looked for. Most of the land had, however, been out of cultivation for three years. Except at isolated points there were not many shell holes, but trenches and their protective belts of wire ran in all directions and were the first task for the Agricultural Companies.

Of the 45,000 acres which comprised the whole, it was proposed to set aside 12,000 acres for potatoes, of which there had been frequent shortages at certain periods in the past. If this acreage had been achieved it would have gone far to meet the total needs of the British Expeditionary Force. The remainder of the area was to be planted with oats, although it was realised that the resultant crops would have but little effect in reducing the tonnage which would be involved in keeping the British Army supplied in this respect, and it was for this reason that the more bulky crops, such as potatoes, were decided upon.

The tractors used were of five types. "Moguls" of three different horse powers, the "Emerson" and the "Allis-Chalmers." They were equipped with three-furrow self-lift ploughs of the "Oliver" and "International Harvester" types. Two drivers were allotted to each tractor, as they became trained, in order that each machine might be kept working at its maximum capacity. All tractors were filled with petrol and oil over night, so that no delay might occur in starting up next morning.

Cultivation of the land other than by ploughing was carried out with convalescent veterinary base horses which, in many cases, had been blinded by gas and were only of value for comparatively light work on the land.

It was on these lines that work went forward until 21st March, and on that date the great German offensive opened.

It is hardly within the scope of this article to discuss this offensive from the military point of view. In selecting the Roye area as the scene for agricultural operations, it had been contemplated that it was sufficiently in the rear of the battle zone to render it improbable that the agricultural operations would have been interfered with by a temporary military success on the part of the enemy. It would be idle to argue here whether such optimism was justified.

There was no time for regret and the officers of the Directorate realised that their first task was to clear the area of all the machinery that had been collected, not only to prevent it from falling into the hands of the enemy, but still more important, to prevent it from encumbering the roads behind the retreating army. The saving of practically everything intact was certainly a gilded page in the history of this short-lived enterprise.

Communication with G.H.Q. from the Directorate Headquarters was somewhat difficult as all the lines were choked with more urgent messages. One message, however, was got through from G.H.Q. on the telephone, ordering the Directorate to move. From that point onwards operations were in the hands of the Directorate.

Orders were given for all tractors and personnel north-east of Roye, viz., on the side nearest the approaching enemy, to concentrate on Roye itself. All other personnel and tractors were ordered to concentrate in the vicinity of the main Roye-Noyon road, with a view to withdrawal south and west. On the 24th March, the general withdrawal started, all tractors proceeding under their own power and all ploughs, rollers and other implements being towed behind horse transport.

The 10 miles to the first objective in the rear was completed without incident, but the news that the German advance was proceeding with rapidity necessitated a further withdrawal immediately. This was again completed without incident and all the columns converged at a point due south of Amiens.

Forced marches had been made and the pace could not be kept up indefinitely. It was therefore decided to make a dump of material other than tractors, which could proceed under their own power, at a village known as Hargicourt. This village ultimately proved the limit of the enemy's advance. It was in fact in the trench lines and was reduced to ruins. By a peculiar freak of war, however, while the whole area round the dump was pitted with shell holes, the implements within were hardly touched, except by shell splinters and were recovered almost intact five months later, when the tide turned.

The withdrawing columns finally reached Rouen after a series of marches which were effected under inevitably trying conditions, and the greatest credit was reflected upon all ranks for the endurance and high sense of discipline which they displayed. At Rouen the personnel was reorganised and sent forward to construct rear lines of defence. The Directorate returned to their old Headquarters at Le Touquet.

Of incidents there were many during the retreat. In one case, an abandoned tractor was pressed into the service of a retreating battery, who were finding it difficult to get their heavy 9-in. guns into action. In accordance with instructions, this tractor had been left with empty water tanks, but notwithstanding, it was put in motion and the engine responded to the call, and although overloaded, pulled the gun into position. The inexperience of the gunner drivers, however, proved too great a test and the tractor, after performing this last service, had to be counted among the missing.

One more incident is worthy of mention, and was not without humour. Two tractors had been loaned to one of the Armies affected by the retreat, for use on the Army Farm, and owing to a belated start, finally withdrew under their own power, practically on a level with the rear guard troops. The mornings were misty; the noise of the engines was unfamiliar; and reports reached Corps Headquarters that German "tanks" had succeeded in passing the line of outposts. Counter steps were immediately taken to deal with a situation, which was only restored when the mist lifted, and revealed two 8/16 "Moguls" making stately and steady progress towards the rear.

ABERDEEN-ANGUS CATTLE.

J. J. CRIDLAN.

Historical Notes.—The rise of this breed to its present pre-eminence is probably the most remarkable of any of our domestic bovine species. The breed is indigenous to the districts which are still its headquarters, the North Eastern Counties of Scotland, Aberdeen and Forfar (Angus) being its chief centres. The precise date at which organic changes have given us the Aberdeen-Angus polled breed remains a mystery, but there is documentary evidence to prove there were in Aberdeenshire cattle without horns more than 400 years ago. The current belief that the native cattle of Aberdeenshire have been black and hornless, time out of mind, is confirmed by a legal document in Vol. III, p. 344, of the Spalding Club Antiquities of the Shires of Aberdeen and Banff. It describes the ceremony observed in putting John Cumyng, of Culter, Aberdeen, into possession of his deceased father's property in 1523. Till 1845, when a property changed owners by death or purchase, sasine or actual possession was given by the Crown or the Superior to the new owner by delivering to him, on the ground, a handful of earth as a symbol of the soil of the property, and a stone as a symbol of the building on it. This was called giving "yird and stane." At an earlier period, when land was held by personal military service, the Crown, before accepting a new owner, claimed a money payment called "relief" from an heir and "composition" from a purchaser. This made sasine-giving a more important function than it was after the abolition of military service tenure.

In the case mentioned, sasine was given by an officer of the Sheriff of Aberdeen called the "mayor of fee," and it was effected by John Cumyng selecting and accepting "unum bovem nigrum hommyll"—a black hummel (hornless) ox—valued at 40s. 8d. Scots. It had represented a plough ox, of which there were at the time eight in the plough team, and indicated John Cumyng's right to cultivate the ground. Being a symbol, and being selected, it is plain that it was of the kind of oxen common and most esteemed in the country at the time, and also that this had been a long established custom.

That progressive Society, The Smithfield Club, did not till 1892 consider this breed to be sufficiently important to allot it a separate classification, notwithstanding the fact that Mr. William

McCombie, "the great deliverer" of Aberdeen-Angus Cattle as he has been aptly called, in 1867 brought the great Doddy Ox "Black Prince" south, and swept away all the leading championship honours from the Birmingham and Smithfield Shows, whence at Her Majesty the Queen's expressed desire, it was forwarded to Windsor for her inspection. Like Saul, William McCombie was head and shoulders above his compeers. Born at Tillyfour in 1805, he died in 1880. He carried on the work of the pioneer, Hugh Watson of Keillor: what Collings did for the Shorthorn, the latter did for the Aberdeen-Angus. In his work "Cattle and Cattle Breeders," William McCombie pays generous testimony to his excellence: "Amongst those who have distinguished themselves as breeders of Aberdeen and Angus polled cattle, the late Hugh Watson deserves to be put in the front rank. We all look upon him as the first great improver and no one will question his title to that distinction. There is no herd in the country which is not indebted to Keillor blood."

Previously to his great successes above mentioned, McCombie had in 1856, 1857 and 1862 won every first prize for Aberdeen-Angus breeding and fat cattle awarded by the French Government at its International Shows, including the Fat Stock Championship of the World. It was not, however, till 1878 that McCombie reached the zenith of his fame as a breeder and feeder, by his triumph over all breeds at the Paris International Exhibition, where a prize of £100 was offered by the French Government for the best animals for breeding purposes bred by the exhibitor in the section of animals other than French. For this trophy, there competed representatives of the Aberdeen-Angus, Shorthorn, Hereford, Devon, Sussex, Ayrshire, Highland, Norfolk, Kerry, Dutch, Flemish, Danish, Berne Fribourg, Swiss, Piedmontese and Portuguese breeds—surely the most representative groups of the breeds of the world ever gathered together. The prize was awarded to McCombie's group, with the group of Sir George McPherson Grant second: the Aberdeen-Angus thus providing the champion and reserve champion winners. More honours, however, fell to the lot of the Doddies of Aberdeenshire. The only occasion on which British and French cattle had any opportunity of testing their respective merits was in the competition for the £100 prize for the best group of beef producing animals, bred by the exhibitor. The adjudicating bench was comprised of 31 members of the various breeds, and by a majority of 24 to 7 the Aberdeenshire group triumphed. It should be noted as affording another

proof of the early maturing characteristics of the Doddies that only one of McCombie's " best beef producing group " of six, was over two years and a few months.

McCombie's ideal in breeding cattle was size, symmetry, fineness of bone, strength of constitution and adaptability to accumulate flesh evenly. Few men in his generation had greater all round experience than McCombie; he dealt largely in commercial cattle, attended the Smithfield markets with regular consignments, and there found that the demand for the Doddy by the London butchers exceeded that for any other breed, and brought more remunerative prices—a feature that impressed the most famous of all present-day Shorthorn breeders, Mr. William Duthie of Collynie, who has stated, " It is some years since I was in the habit of attending the London Christmas market, and in *those* days there was nothing I liked to own, and nothing I liked to stand behind better than a lot of good Aberdeen-Angus cattle." What an appreciation from so great an authority! In *these* days he is modelling the Shorthorn with the Doddy characteristics as nearly as human skill can command.

McCombie's deeds proved an incentive to that able veterinarian, Dr. Clement Stephenson, to carry forward the black " banner with a strange device," the Doddy. He, in 1885, 1887 and 1894, carried away from the Smithfield Club Show the Champion Plate and other trophies. Dr. Stephenson was a keen enthusiast and good judge and did sterling work in promoting the interests of the breed: he will fill a big place in its historical records. Not the least of his productions was his 1885 Champion Heifer, " Luxury," which was a model of symmetry and economical feeding; its carcass gave the minimum of offal to the maximum of prime lean flesh ever registered; the purchaser who slaughtered it testified that the carcass, when quartered, appeared to have no coarse meat at all; there was little more scrag than in a sheep and the smallness of the bone in proportion to the thickness and weight of the carcass was remarkable. The dead weight of this animal was 1,318 lb. showing a percentage of 76¾ dressed meat to live weight, only 23¼ per cent. offal. This record will be hard to beat, if it is ever beaten.

The Earl of Strathmore next entered the lists and emblazoned on the black banner further Smithfield Club Championship victories in 1896, 1898, 1901 and 1902. What a marvellous quartette were those Aberdeen-Angus heifers, " Minx," " Ju Ju," " Layia," and " Brunhilde of Glamis."

The carcass of "Minx of Glamis" was a remarkably fine one, undoubtedly the best of a grand quartette. Other Aberdeen-Angus Championship successes have been won by Earl Rosebery, The Duke of Portland, Col. McInroy, Sir Richard Cooper, J. D. Fletcher and another breeder.

The Aberdeen-Angus as a Butcher's Beast.—How far the points of excellence aimed at by the breeder are appreciated by butchers, is doubtless a question of great interest to those agriculturists who desire to produce the best types of the various breeds of cattle indigenous to Great Britain, and whose successful efforts have been rewarded by raising their country's cattle to such an eminence that its stock is sought by every country suitable for cattle breeding. The value of these efforts to the butcher continues to be exemplified abroad, especially in the United States of America, Argentina, and in recent years New Zealand and South Africa, from which sources we have been drawing huge supplies to feed our teeming millions. So far as the first country is concerned, these supplies of beef are almost a thing of the past; it is now difficult for it to feed its own increasing population. Notwithstanding its great commercial development and its millions of acres, its cattle breeding industry has not kept pace with its expanding population and national progress, and consequently it has now to resort to importations from the Argentine and elsewhere.

The estancieros of Argentina, wise in their generation, had with much foresight and unstinted outlay raised up from its Criolla (native) stock by the aid of the best British bulls, principally Shorthorn, vast herds of commercial cattle suitable for exportation. When in 1910 I was invited by its great Rural Society to judge Aberdeen-Angus cattle for the first time, I found the Shorthorn very popular and in the ascendant, the Hereford with a wealthy and important following, but the poor Doddy the despised and rejected of men. The merits of the Aberdeen-Angus were only appreciated, with one or two exceptions, by the smaller and less important section of breeders, but what a revolution of opinion and esteem has occurred in 10 brief years! One dared hardly then mention the incomparable merits of the Aberdeen-Angus before being "sat upon" by the enthusiasts of the other two breeds.

The American packing houses were, however, just opening their first great plant, and knowing so well its mode of procedure, I was very optimistic and prophesied those coming events which were casting their shadows before. The English

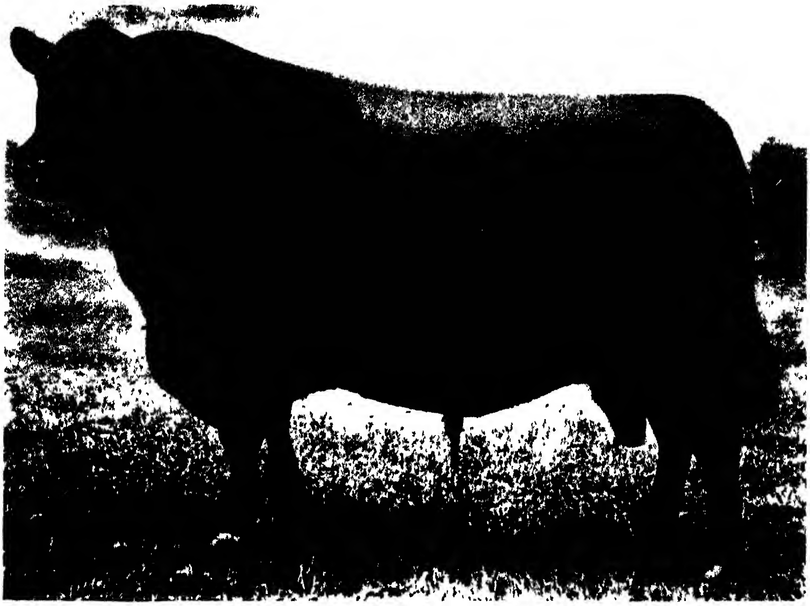

FIG. 1.—Champion Bull of Aberdeen-Angus Breed. Winner of 6 Gold and 9 Silver Medals.

FIG. 2.—Champion Heifer of Aberdeen-Angus Breed. Winner of many Gold and Silver Medals, and Cups.

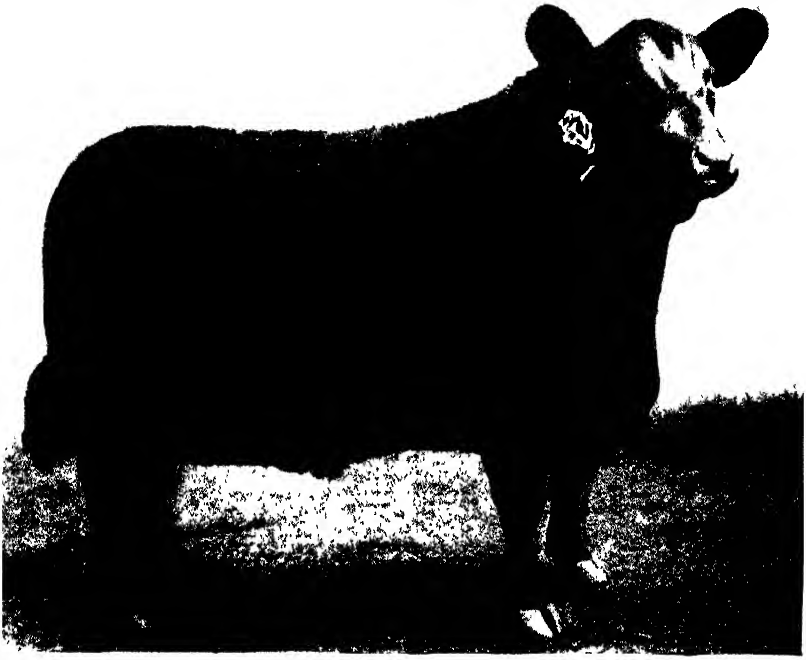

FIG. 3.—Champion Steer of Aberdeen-Angus Breed. Winner of several Prizes and Cups.

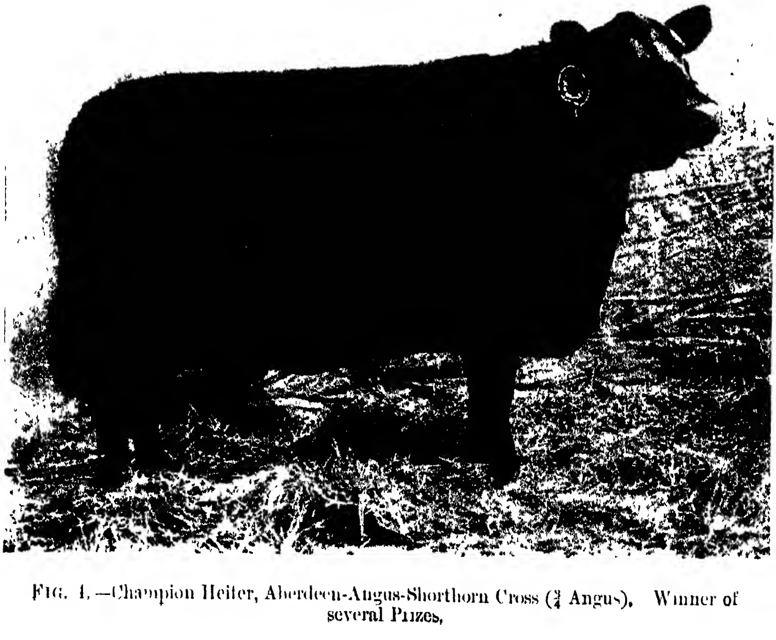

FIG. 4.—Champion Heifer, Aberdeen-Angus-Shorthorn Cross (¾ Angus). Winner of several Prizes.

packing houses had been and were buying the cattle by the lump, if I may so term it, irrespective of quality: that was not the policy of the Yankee. Quality rules in the Smithfield market, and the aim of the American companies has always been to secure the best clientèle there, viz., the meat traders who require the best article and give the highest prices. I paid visits to nearly all the leading packing houses and leading estancias and advocated the production of baby beef, a series of two-year-old bullocks in the place of the 4, 5 and 6-year-old oxen that were so common. Experience of 30 years on the Smithfield market gave the assurance that the uplifting of the Doddy in the appreciation of this great country was on the horizon. Another feature that made assurance doubly sure was the prospective Show of Fat Cattle, the first of its kind in South America, at which I was invited to stay and judge. A new epoch was opening; the show proved a great success. There were few Doddies exhibited, and the leading honours went to the Shorthorns and Herefords, but it meant salvation to the Aberdeen-Angus, for a fat cattle show without representatives of the black and comely would be like Shakespeare's greatest play, Hamlet, without its sable-clad Prince of Denmark.

Figures published recently by the Rural Society of Argentina show that the Aberdeen-Angus is now second on the list of the pure-bred herds of the beef cattle of Argentina, the Aberdeen-Angus being more numerous than the Herefords. Pure bred Aberdeen-Angus bulls are sought after for crossing purposes, as no better steers for the butcher can be raised than its cross with the almost universal Shorthorn. The Secretary of the Argentine Angus Society—Senor Ricardo Hogg—has published the fact that in the neighbourhood of Concordia alone, there are now 300,000 black cows. Mr. James Sidey, the oldest exporter of cattle to the Argentine, told me at the Highland Society's Show that he had received from his partner in that country a cablegram advising him to sell all purchases possible at home with the exception of Angus. Such straws show which way the wind blows: the demand of the packers there is now for the animal with the maximum of meat for roasting with a minimum of coarse.

In an article some years ago* I gave particulars of specimens and measurements of our various cattle of 100 years ago, which then met the requirements of the butchers and the public; but unless one has the engravings and measurements of those

* Farmer and Stock Breeder Almanac.

monster animals before one it is difficult to realise the results attained by breeders of the 20th century, who by selection and registration have evolved the type and quality of the breeds exhibited at our present-day shows which give so much satisfaction to the butcher and the public, not the least important feature being early maturity.

Towards the end of the last century the London and country butchers began to resent the character of cattle exhibited at the Smithfield Club and other shows. The cow and ewe classes then in existence proved sources of loss, the character of the meat being so wasteful as to be useless to the customer and unprofitable to the trader. Protests were made and the Council of the Smithfield Club eventually deleted such classes from its schedule. The abolition of the cow and ewe classes did not, however, entirely meet the objections to show cattle from the butcher's point of view, and further pressure of the meat traders caused the institution of .the Carcass Section by the Club, the Council of which eventually generously provided funds for handsome prizes, and the Section is now acknowledged to be very popular and highly educational. This Section is open to all breeds and is now judged by members of the meat trade, whose awards have given general satisfaction, and definitely fixed the superiority of the Angus, which either in its capacity as a pure breed or its value as a cross (principally with that other great breed, the Shorthorn) has produced the champion carcass of beef on every occasion but one, viz., in 1903, when a Welsh runt took the laurels.

The carcass competition was established in 1895, and champion prizes were first given in 1899. Since then the Angus breed has been successful on five occasions, the Angus-Shorthorn Cross on 15, the Angus-Hereford once, the Angus-Dexter once, and the Welsh once. Thus in 23 competitions, Angus and Angus crosses have been supreme on 22 occasions: a remarkable record that cannot be explained away.

A memorable date in the annals of Aberdeen-Angus Cattle was 1892, the first year distinct classes were allotted to the breed at the Smithfield Club Shows. In the main section since (26 shows) pure Angus cattle have won the Championship 14 times: Aberdeen-Angus and Shorthorn crosses twice. Such a record is so striking that it needs no adjectives to accentuate it; yet, the records created by the Angus at the Great International Show in Chicago are even more telling. Judged by the most expert members of the great packing

houses, through whose hands millions of cattle of all breeds pass every year, the following results have been attained. The Carcass Competition there was instituted in 1900, and in that year a Shorthorn cross was Champion (what kind of cross is not stated), but every year since that date the Championship has been gained by pure Aberdeen-Angus cattle or a cross therewith, all black and polled. Probably the most remarkable collection of beef animals in the wide world is the Car Load Lots of 15 exhibited there, matched to perfection like a row of peas in a pod. Shorthorn cattle were Champions in 1909; Herefords in 1901 and 1903, and Angus the other 15 years of the competition. Owing to foot-and-mouth disease Smithfield Club shows were not held in 1914 and 1915.

The Aberdeen-Angus most nearly approaches the ideal butcher's animal. As I wrote in the *Live Stock Journal Almanac*, 1910:—" Meat traders, after continued experience with all breeds of cattle are unanimous in awarding the palm to the Aberdeen-Angus; short on leg, small in the bone, deep in flesh of a fine mellow grain throughout, with well-rounded hooks and buttocks, it is undoubtedly the best type of what a beef-producing animal should be. Even its coarse parts are more valuable than those of other breeds, the flanks and briskets have greater depth of flesh and are interspersed with less wasteful fat and gristle." I have likened the Angus to a student of economy:—

" It does a bit at every bite
And makes the most of every mite."

In other words, it puts on fat so regularly and smoothly throughout that no loss is occasioned to the butcher by having to trim unnecessary fat from parts of the carcass. The butcher hates patchiness, which is an evil all breeders should avoid and use their best endeavours to eradicate. Shorthorns and Herefords are very prone to accentuate this fault, especially when fed for fat stock shows, on the tail head, the hooks, ribs, brisket and flanks. Brought up in my youth amongst these two breeds, I had a predilection for them, and the height and goal of my ambition at that time was to possess a herd of either; but later experience proved incontestably that the Angus cattle were supreme as beef producers of the choicest quality, and as " market toppers " in price could not be equalled.

This opinion is not biased or unique amongst meat traders. Mr. James Brown, chief cattle buyer for Armour and Co., who judged the car load lots at the International Live Stock

Exposition in 1909, the only occasion when the Shorthorns have won this great prize, states: " An Aberdeen-Angus steer is an ideal animal from the butcher's standpoint, the ripe Aberdeen-Angus has no superior. The average market performance of black cattle as indicated by the prize list, demonstrates their quality, the meat marbles well. They are high dressers, being short-legged and chunky, the meat is in the right place with a high percentage of choice cuts. They cut up with minimum waste, hence the popularity of beef carcasses that have been divested of black hides, with the retailer. Buyers are of necessity impartial to breeds; their mission is to get good cattle regardless of colour or history. 'Blood will tell,' and when a buyer locates a drove of well-bred finished Aberdeen-Angus, he knows he has an opportunity to buy *something* They are smooth, the proportion of weight in loin and rib (the most valuable parts) is uniformly heavy." Henry du Plan, buyer for another large packing house, who judged car load lots in 1907, states: "No better cattle come to market than Aberdeen-Angus. A load of black bullocks of the same quality and finish as a load of any other kind, will invariably elicit a bid 10 cents higher than the buyer would feel justified in offering for others. The statement that the black is an ' honest bullock ' explains this. When he starts a load of black ones towards the scales, he does it with the conviction that not only will he get a high percentage of beef, but it will be good meat. One reason the butcher is partial to them is that they are fine boned, and when an experienced retailer enters a beef cooler (refrigerator) to select material to replenish his stock, he invariably begins a patient search for the black ones, frequently surprising beef men by the certainty with which he picks them out of the mass. A black carcass is always a nice carcass, and my experience justifies me in stating that there are fewer counterfeits in this breed than in any other." Such is the universal opinion of meat experts, an opinion so recently endorsed by the sale of Canadian cattle bred and fed in Alberta and brought over at the instigation of the Honourable Duncan Marshall, Minister of Agriculture, to demonstrate the class and quality of the stock being raised in the Dominion. There were 7 Herefords, 6 Aberdeen-Angus and 2 Shorthorns, sold by auction to leading butchers, and the Angus averaged £10 per head more than the other breeds, and what is even more incisive 2d. per lb. higher in price.

The biggest classes at Fat Stock Shows are undoubtedly

those of the cross breeds, and here the supremacy of the Angus in conjunction with the Shorthorn is incontestable. The Angus-Shorthorn and Shorthorn-Angus crosses provide about nine-tenths of the entries, and these breeds undoubtedly " nick " more advantageously than those of any other two breeds, and produce a blue-grey or black commercial animal for beef purposes, second to none. They also carry off the great bulk of the prizes both in the main cross-bred section and carcass competitions. The butchers appreciate these crosses highly and acknowledge the grand work done in the past century by the breeders of pedigree stock in evolving breeds so suitable for their purpose to feed the epicure and the multitude.

The crucial question at the moment to the butcher and the public is: Where are we to look for our future supplies of meat? Many countries are being tested and exploited.

Brazil has huge potentialities. Henry Savage Landor in his thrilling and interesting work " Across Unknown South America " has discovered and brought to light vast grazing lands, untenanted by animal life, which are well watered and capable of sustaining very many millions of cattle.

Uruguay with its 37,500,000 acres of pasture land devoted to cattle raising.

Paraguay, where a Chicago firm recently bought 20,000,000 acres of land (and had 12,000,000 more acres in Argentina and Uruguay under offer).

Rhodesia and the Northern Territories of *Australia*, are all capable of producing and supporting vast herds. These countries are already being exploited, and numerous packing houses have been established during the past few years.

This subject is, however, too great a one to more than touch upon. Volumes of interesting matter could be written upon a matter so vital to the future well-being of our country. Very many of our pedigree cattle will, however, be required and exported to these countries before the produce are suitable, from the home butcher's point of view, and as the ultimate destination of all cattle is the block, it would be to the advantage of all breeders to keep in their mind's eye those essential points which enhance the value of all breeds to the butcher.

THE BREEDING OF GEESE:

A Profitable Addition to the General or Poultry Farm.

STANLEY STREET-PORTER.

DURING the last few years probably no industry in this country has seen a greater development than that of poultry keeping. That which in the past was regarded by most as merely a hobby is now recognised as a serious and profitable industry.

It is encouraging to note that up-to-date progressive farmers are at last alive to the fact that poultry keeping on modern lines forms one of the most profitable adjuncts to general farming.

The breeding of geese is a branch of the industry that has been greatly neglected in this country, and yet it is one of the most profitable to farmers and others possessing grazing land.

Many farmers have a deep-rooted objection to geese, under the impression that they spoil the grazing for other stock, and it is commonly stated that cattle, etc., will not graze after geese. It is quite true that a large flock of geese does consume a considerable quantity of grass, but for that matter so does a large flock of sheep; and, as a practical farmer himself, the writer can absolutely disprove the fact that cattle will not feed after geese, and has found that geese pay well for all they consume. Further, the manurial value of a flock of geese, if not run too thickly, is very great on poor grazing land.

An additional advantage is the fact that the birds do not *need* a rich pasture, but will grow and thrive on poor common land, of which there is a considerable quantity in many parts of the country. They might also be kept with advantage in smaller numbers by small-holders and cottagers with suitable grazing in the vicinity.

Given suitable grazing, there is probably no other branch of poultry keeping more profitable than the rearing of geese. Unlike fowls and ducks, which need constant feeding and care, geese will forage for their own living, and after the first few days will require practically no grain or meal ration, no expensive scratching shed, and little attention so long as adequate grazing is available. Under these conditions they will feed and look after themselves and make very rapid growth.

Before the War large quantities of geese were reared in Ireland and exported to this country to be fattened. In some

districts they were purchased in considerable quantities, run in large flocks over the stubbles after harvest, and sold as "Michaelmas" geese. To what extent this is carried on at the present time the writer is not aware.

Italy, France and Germany are also large producers of geese, and in Germany the breast of the goose is smoked and considered a delicacy.

Breeds.—Of the various breeds of geese probably the best known are the Embden and the Toulouse, while the Chinese is also well known. Another breed, which is not so well known in this country as the others, is the "Roman," which the writer considers the best "commercial" goose of all. Personally, however, he has only kept two of the above-mentioned varieties, viz. the Roman and the Toulouse. Both of these varieties undoubtedly have their good points. The Roman might be aptly compared to White Wyandottes or Rhode Island Reds and the Toulouse to Indian Game or Dorkings, since the Roman goose resembles the breeds of fowls with which I have compared them in being of moderate size and far more prolific as layers than most other breeds of geese—with the exception possibly of the "Chinese"—whilst the Toulouse is undoubtedly the best heavy-weight Christmas goose obtainable. The Toulouse are very massive and majestic in appearance and do not make the rapid growth of the Roman, but though they are slower in attaining maturity, they make fine heavy-weight geese by the end of the year. Toulouse geese usually commence laying in February, and after laying their first "clutch" of eggs, go "broody," afterwards laying a second, and as a rule smaller batch of eggs than the first. In colour the Toulouse is a dark grey with white under, and is the most handsome variety we have.

Roman geese are much smaller than either Toulouse or Embden. They have a very smart, alert carriage and are splendid foragers. In colour they are generally white, though some have grey markings on head and neck. They weigh from 12 to 14 lb. when mature, are finer in bone than the Toulouse, and carry more flesh in proportion to offal than the heavier breeds. No standard has yet been fixed for this breed in England, and consequently they are not provided for at any of our large shows and are only in the hands of a comparatively few breeders. They are probably the most prolific geese in existence, and like the breeds of "laying ducks" such as Runners, Buff Orpingtons and Khaki Campbells, they breed

quite satisfactorily without swimming water, and unfertile eggs are the exception.

As this article is written with the object of encouraging the breeding of geese for market purposes, no apology is made for drawing special attention to this particular breed, which is undoubtedly *the* " utility " goose of the future. The birds are very active foragers and extraordinarily quick growers, and if reared on grass and then run on the stubbles after harvest are very profitable to sell as " Michaelmas " geese.

Roman geese generally come into lay towards the end of January or early in February. Although they are rather addicted to broodiness, and will generally go broody four or five times during the season, if shut up at once they are easily broken of this, and the writer has frequently had them laying again in 7 or 8 days. If required to hatch their own eggs they make very reliable sitters and splendid mothers. If it is wished to break them of broodiness they should be taken the first night they remain on the nest, put in a raised coop with slatted bottom and fed liberally, when they will soon recommence laying.

The writer has little knowledge of either Embden or Chinese geese. The former are white and better layers than Toulouse, though not so large; they are frequently crossed with the Toulouse for producing market geese with good results.

Breeding and Feeding.—In making pens for the breeding season one gander may be mated with three geese. Second or third season geese are most suitably mated to a year-old gander, though good results may be obtained from first-season early-hatched geese of the Roman breed if mated to a second-season gander. It is preferable if the breeding stock can be given free range and swimming water, but the writer keeps a large number of pens of Roman geese for pedigree purposes and all are kept in confined pens during the breeding season without swimming water. In spite of this the birds are prolific as layers and their eggs are very fertile. This method, however, is not so satisfactory as regards the Toulouse breed, which, to give the best results, requires free range and water to swim in.

Through the breeding season, particularly where geese are kept in comparative confinement, the birds should be fed liberally to obtain a maximum production and the best hatching results. During this period one good feed of grain and one of soft mash are given each day.

As in the case of ducks, geese require a greater proportion of animal food in their mash than fowls. Bran, middlings, maize meal, Sussex ground oats and fish meal in equal parts make a good, serviceable mash for the breeding season, while a grain feed consisting of equal parts of sound oats and kibbled maize fed in troughs in their drinking water is recommended. Grit and oyster shell should also always be available for them in their drinking water.

For the Christmas trade geese require fattening to bring them into proper condition. For this purpose they should be shut up in an open-fronted shed and given all the food they will consume. This should be mainly a mash composed of maize meal, Sussex ground oats, barley meal, and if available some boiled potatoes may be mashed up with the meals; about 10 per cent. of fish meal or meat meal may be added with advantage. White oats of good quality, which should be steeped in cold water for some hours before feeding, also form an excellent food to produce fine quality flesh. Food may be given two or three times a day when fattening, but any food left over should be removed from the troughs after they have finished feeding; if left over until the next meal there is a danger of them going off their feed. Grit and fresh clean water should always be available, but the geese should not be allowed swimming water whilst fattening.

The shed in which they are confined should be kept well littered down with clean straw and the birds let out for a good swim before being killed, in order to cleanse their feathers.

Hatching and Rearing.—The chief trouble in hatching geese is the fact that they commence to lay freely early in the season at a time when there is usually a great dearth of broody hens. Whilst by force of circumstances the writer has had to resort to artificial methods of incubation, he cannot say that this method of hatching has even given what may be considered sufficiently satisfactory results, and does not therefore recommend hatching the eggs in incubators if broody hens are available. To overcome the difficulty the writer determined two years ago to produce broody hens for the purpose, and mated some Silkie cockerels with White Wyandotte, Rhode Island Red and Buff Orpington hens. The produce of any of these first crosses make ideal broody hens for hatching pheasants, ducks or geese. They are small but wonderful sitters and mothers, and after laying a few eggs will invariably go broody, and may rear several broods during the season.

Since following this method I have never been short of broody hens, and they have invariably given good hatching results.

If goose eggs are hatched artificially the temperature of the incubator should be 102° F. as in the case of ducks' eggs. It is advisable to sprinkle the eggs once a day with water (with the chill off) and as soon as they begin to " chip " a piece of flannel or old blanket should be well soaked in warm water and laid over them for about 10 minutes; this will help to soften the membrane of the shell and give far better results than would otherwise be obtained.

There are few prettier sights than a flock of newly-hatched goslings, and almost from the first they commence to fend for themselves and nibble at the grass. They do not need so much brooding as chickens, and a hen of ordinary size will bring up 15 or 16 if a good mother.

When artificial rearing is resorted to, the brooder should not be at as high a temperature as for chickens; the amount of heat required would vary according to the number put in, as the goslings will themselves generate a considerable amount of heat. This of course also applies to chickens and ducks, and the novice frequently suffers considerable loss from the mistake of putting a few chickens into a foster mother early in the season with insufficient heat, or again in warm weather by placing too many in a brooder, when they become overheated. If a fair number of goslings are put into a brooder very little heat is necessary after the first two or three days.

Goslings can be fed practically the same as chickens or ducklings, with a little bran, middlings, Sussex ground oats and maize meal mixed crumbly. If given a chance to range they will soon provide for themselves. After the first fortnight during mild, open weather, they need not be fed at all if given free range, unless required for early killing. If sold as " Michaelmas " geese they can be picked up for killing from the stubbles, provided there has been a sufficiency of grain to put them into good condition. It is of course, a mistake having built up the frame at a very low cost to market the geese in poor condition, and even though they have had good " shacking " on the stubbles it may be found necessary to give a little fattening meal to " finish " them. This will add to their weight and naturally give them a plumper appearance when dressed for table. Incidentally, flesh of a better flavour and quality will result.

During the next few years every farmer will need to produce everything possible from his holding (whether it be large or small) that will yield a profit, and he can no longer afford to regard poultry keeping as of no importance. Many farmers to-day, by keeping well-bred poultry on modern lines, are making a profit which goes a long way towards paying their rent, but whether they keep poultry as a serious adjunct to their business or not, there is no reason why on many farms a breeding pen of geese and some well-bred laying ducks* should not be kept. This would not entail the displacement of any other stock, and in the aggregate would add considerably to the revenue derived from the farming industry and also to the food produced in the country.

Payment of Claims under the Corn Production Acts.

IN accordance with the Corn Production Acts (Repeal) Act, 1921, payments in respect of wheat and oats of the 1921 crop are payable on 1st of January, 1922, and payment cannot in any case be made before that date.

The Ministry will, however, endeavour to issue by the end of November a letter of notification to each claimant who made a claim in the prescribed form before 18th July. This letter will only state the amount due, the actual Pay Order being issued at the end of December. The above arrangement will not, however, apply to claims made after 18th July or to claims which require fuller investigation. These will be dealt with as soon as possible after the completion of the examination of the first batch of claims, and Pay Orders will be issued without any letter of notification.

The total number of claims now received is approximately 200,000. The task of dealing with this number of claims is a very considerable one, and it is hoped that farmers will appreciate the fact that the Ministry is making every effort to ensure that payments shall be made by 1st January next.

Occupiers who have made a claim on the proper form and have received an acknowledgment are requested to refrain from writing to the Ministry on the subject as such correspondence tends to delay the work of examining and dealing with the claims.

* See this *Journal*, April, 1921, p. 54.

IMPROVEMENT OF DAIRY CATTLE IN DENMARK.

HARALD FABER,
Danish Agricultural Commissioner in London.

The first part of this article, published in the October issue of the JOURNAL, *deals with the influence of Milk Recording on the Breeding of Dairy Cattle, the method of keeping Family and Official Herdbooks; and the Inheritance of Milk Yielding Capacity through the Bull.*

Influence of Bulls on Milk Yield.—When the milk recording societies had worked for a considerable number of years, and something like 15,000 herds including 250,000 cows, or about one-fifth of all the cows in the country, were entered in the societies, a very considerable amount of information was available annually as to the yields of individual cows and as to their sires and dams. As a result of the measures already described, many good bulls were being used in the country, chiefly in the many Cattle Breeding Societies. These bulls were mated with dams with recorded yields and the yields of the offspring were also recorded. All that was required, therefore, was *a systematic investigation of this vast material* of the milk recording societies in order to bring out in figures the influence of the different bulls on the yield of their progeny. The Law of 1912 on Breeding of Domestic Animals, therefore, made it a condition for obtaining the Government grant to milk recording societies that the societies should send annually to the Federation of Agricultural Societies of their respective Province a report with a list of all the cows controlled by the society. The report must show for each cow the name or number, day of birth, sire and dam, record of yield of milk by quantity and quality, amount of food consumed (by "food units") and the day of calving, with information of the marking of the calf and how it has been disposed of. It was further provided that the Provincial Federations shall, as far as possible, tabulate this statistical material and publish such reports based thereon as they consider to be of interest to the cattle breeding industry. These records, properly tabulated, evidently contain the necessary material for judging the influence on the yield of the progeny of the parents and particularly of the sire.

These investigations are now carried out to a large extent in

the different Provinces by the officers of the Provincial Federations, and the Government gives a grant of £500 to help to defray the cost.* *The influence of the sire is found by comparing the yields of dams with those of their female progeny by the sire.* The character of chief interest in a butter-producing country like Denmark is the percentage of fat in the milk. In some cases, such as in Funen, the quantity of milk is also taken into account.

The following table shows the influence of five bulls of the Jutland Breed on the percentage of fat in the milk of their female progeny. It records in the case of each bull the average percentage of fat in the milk of the dams and of their progeny by the bull, the number of progeny being also stated. In the last two columns are given the calculated amounts of butter yielded by 6,000 lb. of milk, by dams as well as by their daughters by the sire in question.

Name of Bull	*Number of Progeny*	*Average Percentage of Fat in Milk of*		*Calculated yield of butter from 6,000 lb. of milk of*	
		Daughters	Dams	Daughters	Dams
				lb.	lb.
1. Assistent II	66	3·87	3·50	260	234
2. Assistent Lem	49	3·84	3·47	258	232
3. Assistent Aksel	99	3·72	3·28	250	218
4. Assistent Toftegaard	26	3·63	3·27	242	218
5. Emb Britten	46	3·71	3·36	250	224

It will be seen that these five bulls have influenced the milk of their progeny so as to raise its content of fat from 0.35 to 0.44 per cent. above the percentage of fat in the milk of their dams, so increasing the average butter production by more than 10 per cent. The bulls numbered 1, 2 and 3 are brothers, and 4 is a son of 2. These four belong to the prominent bull family "Assistent" with many members in the Herdbock of Bulls of the Jutland Cattle.

Many similar records of the influence of related bulls on the yields of their progeny can be extracted from the herd books of Danish dairy cattle. Mr. Mörkeberg has kindly sent me the

* On the Budget for the financial year 1920-21 the following amounts in aid of cattle breeding were included, according to the Law of 8th June, 1912, as amended 12th February, 1919 :—

Prizes at Agricultural Shows	£6,000
Prizes at Provincial Shows	1,500
Prizes for Bulls at State Shows	2,000
Cattle Breeding Societies	6,000
Milk Recording Societies...	6,000
Competitions for whole Herds	500
Tabulating Reports from Milk Recording Societies in order to find the influence of parents on their progeny	500

NOTE.—The two first items are for prizes for all animals, so that only part of these sums is available for prizes for cattle.

following records concerning members of a bull family of the Red Danish Dairy Cattle.* The "Birk" Bulls, with the years of their birth, are arranged in the following genealogical table:—

1. Birk, 1899.

2. Hermod, 1903. 3. Birk Nakke, 1904. 4. Birkfus, 1904.

5. Jason, 1906. 6. Thjalfe, 1906. 7. Kretheus, 1907.

The following table gives for each of these bulls the number of progeny by various dams, also the average yield of milk, percentage of fat, and calculated yield of butter, for both dams and their progeny. *These averages are calculated for corresponding years*, taking the yields of the dam only for as many years, beginning with the year of first calving, as the years for which the yields of her progeny are known.

Bull	Progeny.				Dams.		
No.	Number	Yield of Milk	Fat per cent.	Yield of Butter	Yield of Milk	Fat per cent.	Yield of Butter
		lb.		lb.	lb.		lb.
1	59	8,424	3·94	372	7,962	3·70	330
2	21	9,302	4·35	453	9,731	3·81	414
3	30	9,053	3·83	387	8,639	3·38	326
4	10	9,214	3·91	403	9,000	3·46	345
5	33	9,229	4·25	440	8,884	3·73	367
6	34	8,582	3·91	374	8,793	3·56	350
7	27	9,427	4·05	427	8,534	3·65	348
Averages:		9,033	4·03	408	8,792	3·61	354

The average influence of these seven bulls on the yields of their offspring has been to increase the yield of milk slightly, by 2.7 per cent. above that of their dams, and to increase the percentage of fat in the milk by 0.42, the effect being to increase the average yield of butter of the offspring by 54 lb. per annum (or 15 per cent.) above that of their dams.

It will be noticed that while for *two* of the bulls, Nos. 2 and 6, the average *yield of milk* of the offspring was *lower* than that of their dams, the average *percentage of fat* in the milk was *increased in the case of every bull*, the increase ranging from 0.24 to 0.54 per cent.

This development of the work of the milk recording societies

* These records are from reports by J. Fr. Pedersen, Odense, 1915, and by J. Fisker, Copenhagen, 1921, to the Provincial Agricultural Federations in Funen and Sealand respectively.

—the determination by means of the milk records which bulls are able to transmit to their progeny the character of high yield of rich milk—has modified the aim of the modern breeder of dairy cattle. The line-breeding which hitherto had been the principal feature was found to restrict unduly the number of animals between which to choose sires and dams. What is now mostly desired is to find bulls with a good influence on the milk yield. Both within the Red Danish Dairy Cattle and the Jutland Breed, much of the progress during later years can be traced back to the influence of a few bulls having remarkably strong power to transmit higher milk yielding capacity to their progeny.

The use of milk records in the breeding of dairy cattle both by line-breeding and by employing bulls selected as explained above, has now been carried on by many breeders for a sufficient number of years to show definite results. The following figures are taken from the records of various herds of the three breeds, the Red Danish, the Jutland and the Shorthorn, mostly herds of moderate size, owned by peasants in various parts of the country. They give the average yields of the herds at two different periods.

RED DANISH BREED.

Year.	*Yield of Milk.* lb.	*Fat.* per cent.	*Yield of Butter.* lb.
1905–06	8,941	3·58	356
1915–16	10,041	4·11	462
1905–06	9,427	3·40	356
1915–16	11,282	4·30	546
1900–01	9,104	3·45	350
1914–15	10,366	4·19	486

JUTLAND BREED.

Year.	*Yield of Milk.* lb.	*Fat.* per cent.	*Yield of Butter.* lb.
1900–01	5,315	3·09	183
1916–17	8,175	3·87	354
1897–98	5,922	3.01	196
1913–14	8,538	3.84	367
1900–01	6,228	3·42	240
1913–14	8,844	3·90	385

SHORTHORNS.

Year.	*Yield of Milk.* lb.	*Fat.* per cent.	*Yield of Butter.* lb.
1903–04	6,349	3·30	238
1915–16	9,445	3·85	407
1901–02	6,864	3·62	277
1911–12	10,164	4·06	460

Many more instances could be given of herds with a similarly improved yield, because these results are not obtained merely by a few eminent breeders but by many farmers, large and small.

The best cattle on the islands had already attained a fair yield of milk before the beginning of this century; they have therefore relatively gained most in respect of the richness of their milk. In Jutland, on the other hand, the greater increase has been in the quantity of milk. Averaging 18 herds of all three breeds during a period of about 14 years there has been achieved the very creditable result that the production of butter has been increased by more than fifty per cent., while the yield of milk has been increased by 26 per cent.

The influence of the progressive farmers on their neighbours has tended to raise the general standard of the dairy cattle throughout the country. Even farmers who take no part in the work of the milk recording societies reap a certain amount of benefit from these as they learn where good animals for breeding can be bought.

Grants for Prizes at Shows.—It has already been mentioned that by the Law of 1912 on Breeding of Domestic Animals the State made it a condition for giving grants to milk recording societies that they should send a report of yield and pedigree of each tested animal to their respective Provincial Agricultural Federation. The State took further steps to encourage the breeding of animals with good records, by making certain stipulations as to the grants to agricultural societies to be used to supplement prizes at shows. Section 3 of the Law of 1912 contains the following provisions:—

> "After the expiration of two years from the enactment of this Law no grant shall be given for prizes for bulls of dairy breeds unless reliable information be given of the yield of milk of their dams by quantity and by percentage of fat.
>
> "After the expiration of five years from the enactment of this Law no grant shall be given for prizes for cows of dairy breeds unless reliable information be given of their yield of milk by quantity and by percentage of fat."

It is worthy of note that, as in most similar aids to agriculture given by the Danish Government, these provisions did not introduce anything new or show the farming world a novel development, but rather confirmed and made of general application what had already been introduced by some of the agricultural societies and found to be practical and useful. At the time when the Law of 1912 was being drafted, the conditions requiring information as to yields had already been in force for years at many of the agricultural societies' shows on the islands. They had not been applied to the same extent in Jutland, although at a Jubilee Show in 1897 the Federation of Jutland Agricultural

FIG. 5.—Family group of Red Danish Dairy Cows.

Owner : Lars Jensen Tvindelstrup.

Average yield per Cow for all Cows in one year · 10,758 lb. of Milk, 3·85 per cent. of Fat. 463 lb. of Butter.

FIG. 6.—Family group of Cows of Jutland Breed.

Owner: Soren Sorensen. Hornum.

Average yield per Cow for all Cows in one year . 9,962 lb. of Milk, 3·75 per cent. of Fat, 417 lb. of Butter.

Societies had made it a condition for competing for prizes in a class for "butter cows" that in order to be eligible the cows should have records of their yields as supplied by the milk recording societies.

At shows the records of milk yield now form an important part of the judging, but they are used somewhat differently in the different Provinces. The local agricultural societies and the provincial federations of such make their own rules for their local, provincial, or State shows—rules which naturally conform to the provisions of the Law regarding grants by the State, but which are usually considerably more stringent. It would need too much space to explain the various rules of the different societies, and it will be sufficient for the present purpose to give some of the rules for the provincial shows held by the Associated Agricultural Societies in Funen.

Cows are admitted only when reliable information is given of their milk yield, by quantity and quality, and young stock only when such information is given concerning their dams. The milk records may be obtained from the Biennial Competitions of Whole Herds, from the Laboratory of Agricultural Research at Copenhagen, or from the milk recording societies.

Red Danish cattle are shown in eight classes, the five first consisting of individual animals, the three last of collections:—

1. Bulls aged 1 to 1½ years.
2. Bulls aged 1½ to 2 years.
3. Bulls aged 2 to 3 years.
4. Cows from herds of four cows or less.
5. Heifers, aged 1 to 3 years which have not calved, from herds of four cows or less.
6. Collections of cows. From herds of 15 cows 3 must be shown, from herds of 16 to 30 cows 4 must be shown, and so on until from herds of more than 100 cows 8 must be exhibited. Each of the cows must have yielded an average of 330 lb. of butter per annum, and milk containing 3·60 per cent. of fat; a lower percentage of fat shall not disqualify a cow which has yielded an average of 385 lb. of butter. A special award can be given for a higher yield according to certain rules.
7. Families. The families may be either (1) cows descended from one dam, at least three cows being shown, descended from the cow through the female line, and only one generation may be omitted, or (2) four or more cows descended from one sire. Same conditions as to yield as in class 6.
8. Collections of heifers, aged 1 to 3 years, which have not calved.

When the judging is finished the animals or collections within each class are placed in the show yard in order of merit according

to the number of points gained from judging by appearance—size, build and other external characters.

Particular interest attaches to the rules of judging bulls in the first three classes.

The bulls are judged by appearance, and placed in order according to the points obtained, the finest bull being placed at the head of the line in each class, then the next best and so on. The judges can give up to 24 points, and no bull can be awarded a prize if it gains less than 10 points.

It is a condition without which no bull can compete for a prize at the Show that the milk yields of its dam, dam's dam, and sire's dam have been reliably recorded, and the records must be given up to the 30th September previous to the show if the animals were then alive. It is a further condition that *the dam on an average of all the recorded years shall have yielded 340 lb. of butter, and milk with not less than 3.60 per cent. of fat; or 385 lb. of butter, and milk with not less than 3.40 per cent. of fat.* If the average per cent. of fat in the milk of the dam is below 3.60 but not below 3.50 the bull shall be eligible if the average percentage of fat in the milk of the dam, dam's dam, and sire's dam is 3.60, and if these dams fulfil the requirement as to yield of butter specified for the bull's dam. This average is calculated by first calculating the average of the yields of each cow for all the recorded years and then taking the mean of these three figures. For cows which have calved the first time before the 1st January, 55 lb. of butter are added to their yields of butter for each of the two first recorded years. For cows which have calved the first time between the 1st January and the 1st May, 55 lb. of butter are added to their yield of butter for the second recorded year only.

Besides the prize for judging by appearance already mentioned, the bull can be awarded *a special recognition for descent.* The judges can give up to 24 points for the external appearance of ancestors and their ability to improve the race, as evidenced by information in herdbooks, show catalogues, personal knowledge, etc., and 24 points for the recorded yields of ancestors. This prize for descent does not influence the placing of the bull in the line. On a card suspended from the neck of the bull information is given of the points gained by the bull both for judging by external characters and for descent.

Conclusion.—It has been the writer's aim to show how the work of the milk recording societies has gradually exercised a greater and greater influence on the system of cattle breeding in

Denmark. It first helped to eliminate the wasters, cows that consumed greater money values than they yielded in milk. It then largely increased the usefulness of family herdbooks and official herdbooks by giving reliable information of actual yields where hitherto opinion of the performance of a cow rested on outward signs. It based the judging of entire herds in the biennial competitions on a firm foundation of figures, and did the same for the judging at shows, coupled, of course, with a consideration of the animals as to harmonious build, colour, size and other qualities. It proved that high milk yielding capacity is a character that can be inherited through the dam and, still more important, that it can be inherited through the sire. It thus gave rise to the recognition of "bull families," the male members of which possess the quality of improving the yields of their progeny beyond that of their respective dams. The milk recording societies have undoubtedly been a very great help to the breeding of dairy cattle for milk production; they have, in fact, gone a long way towards reducing it to something like an exact science based on definite figures of yield instead of vague ideas and outward appearances with no known relationship to yield. This influence of the milk recording societies is shown by a very material improvement in the yield. The societies have made milk production more profitable and the breeding of dairy cattle more interesting.

In a butter producing country the percentage of fat in the milk is a very important factor, and the raising of the average percentage has been the chief object of the milk recording societies in Denmark, though they have also aimed at increasing the yield of milk by quantity. When a large milk yield is desired and the richness is not of so great an importance, for instance, where milk is produced for sale and consumption as such, the object of the societies is simpler and should therefore be more easily attained: it is, in fact, a single one instead of a double one. In this connection it is worth while saying that in the opinion of Mr. Mörkeberg: "the capacity to yield much milk and the capacity to yield rich milk are two different characters, both hereditary but inherited the one independent of the other." If that be so it should be considerably easier, aided by milk records, to develop only one of these qualities instead of developing them both.

THE MINISTRY'S RESEARCH (RAT) LABORATORY.

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AT first sight it might be supposed that rat destruction is a simple matter, not offering much scope for scientific research. Such, however, is not the case, for although rat destruction has been carried out for many years by empirical methods, no considerable success has been achieved. Of late years, however, scientists and health officials all over the world have given attention to the subject, and there are gradually being accumulated facts which, it is hoped, will lead to greater success in the future.

The necessity for rat destruction cannot be questioned. Statistics show the enormous material damage, amounting to many millions of pounds sterling annually, caused by rats and mice in destroying property, especially stored and growing foodstuffs; while the danger of rats and mice as carriers of diseases which attack human beings and domestic animals is well known.

Methods of Destruction.—Four methods of rat destruction are available, namely, hunting, trapping, the use of a virus, and poisoning. The rat population is largely limited in numbers by the available food supply and shelter. Adequate rat proofing is therefore desirable wherever practicable: this alone will tend to reduce their numbers considerably.

The first two methods need not be discussed at length; both are limited in their application, and in the case of trapping there is difficulty in taking sufficient numbers to clear badly infested areas. Further, rats soon become wary of traps of all kinds and avoid them. Mention might here be made of the method of destruction known as the "Rodier" system. This depends on trapping alive, destroying all females caught, and releasing the males. It is supposed that the males, then greatly outnumbering the females, will prey on each other and on the surviving females.

The virus method, when introduced some years ago, was hailed as a great advance in scientific rat destruction, but experience has hardly justified the claims made for it. It may be well to explain the method. Some years ago, a French scientist found that the mice in a certain area were dying in unusual numbers, and on investigation the cause was traced to an intestinal germ.

After many experiments he succeeded in isolating and cultivating the germ artificially, and raising its virulence until it was strong enough to kill not only mice but also rats. It had, however, no effect on other animals. The virus method depends on feeding the rats with baits containing cultures of living germs; these infect the animals, which die in 10 or 12 days, and the disease spreads among the survivors. Several types of virus or germ rat poisons have been placed on the market. Unfortunately there are objections to this method which, in many respects, offers an ideal means of destruction. These objections are :—(1) the varying susceptibility of the rats to the disease, as some do not die when they take the germs; (2) sublethal doses tend to immunise the rats to the disease, so that a relatively immune race of rats would be evolved; and (3) there is the risk of the organism used being either initially pathogenic to other animals or developing in its passage through the rat a higher virulence which might affect other animals, and even human beings. Cases of illness in human beings have been attributed to rat virus. (4) Lastly, there is some doubt as to the extent to which the disease is transmitted from rat to rat, for as it is not a contagious disease it can only be transmitted by ingestion of the germs. For these reasons the Ministry of Agriculture and the Ministry of Health do not favour the virus method of rat destruction. Bacteriological science has not, however, said its last word on this subject, and the objections may be overcome in the future.

Poisoning is by far the most important method. With proper precautions it can be used anywhere; when suitably applied it is remarkably effective; and it therefore offers the best solution of the problem at present. Poisons are substances which, when introduced into the living organism, cause death or injury. (Strictly they include disease germs, but for the present purpose these are excluded.) Some substances, such as strychnine and morphine, are dangerous poisons, but if given in small quantities are valuable drugs. Other substances, such as bismuth or iron salts, and strong vegetable purgatives, are not ordinarily regarded as poisons, but if taken in excessive amounts may come within the above definition. There is a large field from which to choose a rat poison.

It should be noted that all methods of rat destruction should be carried out in conjunction with rat proofing, for in the end it is largely the amount of shelter and food available which determines the rat population.

Why Research is Necessary.—From the above remarks on the virus method, it is clear that there is a wide field for further work, which can only be done in properly-equipped bacteriological laboratories by a scientific staff. In the case of poisons, it might be thought that the need for research is not obvious, but poisoning is a certain and much-used method and the need is real. It is necessary to know, for instance, what is the least quantity of poison which will kill a rat of average size; what quantity to put in the bait; and how much bait to use. All these points require experimental tests, and the necessary experiments can only be carried out under a licence from the Home Secretary. Another very important question is the extent to which poisons are dangerous to other animals, and this is one of the chief directions in which research is being carried out, *i.e.*, to endeavour to find posions which, while fatal to rats, will be relatively harmless to domestic animals and human beings. The stability or keeping qualities of poisonous preparations involves much purely chemical research. Even trapping is not so simple as it seems, for experiments in India and elsewhere show that the dimensions of the trap are of great importance.

For these reasons the Ministry of Agriculture, acting on the advice of the Rat Destruction Branch, decided to equip a research laboratory for work on this subject, and further, since the Government were occupiers under the Rats and Mice (Destruction) Act, 1919, it was decided to run a small factory in conjunction with the laboratory for the purpose of supplying suitable raticides for use on Government premises. Apart from this there is an intimate relationship between the work of the Laboratory and the Factory: results obtained in the Laboratory can be checked by practical tests on a fairly large scale.

The Ministry's Laboratory.—The Research (Rat) Laboratory and Factory are situated on the top floor of one of the old blocks at Mount Pleasant Post Office, E.C., in what was once part of the Cold Bath Prison. The staff consists of the Research Chemist (who is responsible for the chemical and biological work and also for the management of the factory), one laboratory assistant, and two men and a boy for the factory work. The Laboratory is equipped, so far as funds permit, with the usual apparatus of a chemical laboratory. In the factory there are mixing machines, a dough brake and biscuit cutter for making rat poison biscuits, a large gas-fired oven for baking, a percolator for preparing Squill extract, a still for distilling water, mincing machines, and other miscellaneous appliances.

The work of the Laboratory includes the chemical examination of various proprietary raticides on the market as well as many rat poisons the formulæ of which are supposed to be secret but which usually prove to contain nothing startling. In addition, raw materials purchased for the factory, or submitted from outside sources, are examined and toxicological analyses made in cases where rat poison is suspected. A large amount of work is done at the request of firms who manufacture or are desirous of manufacturing raticides and are anxious to ensure that their preparations are toxic. A good deal of investigation has been carried out on the various poisons in use as raticides, especially Barium Carbonate, Red Squills *(Scilla maritima)*, Sodium Fluoride, etc.

As an example of the problems to be solved, an account of the Red Squill referred to above may be interesting. The Red Squill is a bulb not unlike a large reddish onion and varies from ½ lb. to 2 lb. in weight. It grows in various countries on the Mediterranean littoral. Very little is known of the chemistry of this plant, and the little that has been published is scattered in various German books, making progress slow. The plant is similar to the Squill of medicine, and its poisonous properties, so far as rodents are concerned, have been known for a very long time, though the white medicinal bulbs do not appear to be poisonous to rats. In the raw state the bulb is poisonous, but baits containing chopped-up bulb do not retain their toxicity very long. If, however, the bait be cooked its keeping quality is greatly increased. The bulbs when dried and powdered are also toxic, though the powders thus made vary a good deal, and the exact conditions necessary for ensuring maximum strength are not understood. The minimum lethal dose of powdered bulb for a medium-sized rat is from 1 to 2 grains. A liquid poison can also be obtained by steeping the bulbs in water and pouring off the liquor. If kept in tightly-stoppered vessels this extract keeps toxic for a considerable time. The actual poisonous substance in these bulbs is not known, though two or three substances are said to have been isolated, but the descriptions are very conflicting. Whatever it is, it must be fairly powerful. Further, it is not known whether the toxicity of the bulb varies at different stages of its growth, though this is very likely, and it is important to know when it is most toxic. Neither is much known as to the exact quantity required to kill domestic animals, though it is certainly relatively large. A South African variety of Squill *(Urginea Burkei)* is being investigated. It appears to

be poisonous to rats. Work has also been done on possible alternative poisons to those in present use, so far, however, with inconclusive results.

Other Poisons.—It has already been indicated that the choice of a poison is very wide; the poisons actually in use, however, are comparatively few. It may be well to summarise the requirements of a practical rat poison. It must be:—

1. Relatively harmless to domestic animals
2. Cheap and readily procurable.
3. Effective on rats and mice, that is, reasonably small doses should kill.
4. Tasteless, or, at any rate, without a repellant taste.
5. Easy and clean to handle and be readily incorporated for making the bait.
6. Capable of keeping well and retaining its toxicity.

These conditions narrow down the choice considerably, and there are not a great many substances which will satisfy them. The first condition practically eliminates all the substances popularly recognised as poisons; nevertheless a great many of the rat poisons on the market contain either arsenic, strychnine, or phosphorus, the last-named being especially popular, partly because it can be bought without the restrictions of the Pharmacy Act, which apply to the first two. Where there is little or no risk of poisoning other animals, the use of these poisons is safe enough, and they are certainly effective, though arsenic is somewhat variable in its results, while the use of phosphorus is attended by some risk of fire. Actually, strychnine is said to be cheapest, per rat killed. As a general rule, however, the indiscriminate use of these dangerous poisons is to be deprecated, and the use of alternative and less dangerous poisons should be encouraged.

Of the less dangerous poisons Barium Carbonate and Red Squill have been found most effective for killing rats. In fact, they are just as good and cheap as the more dangerous poisons, and they have the great advantage of being far less poisonous to domestic animals and human beings.

The Composition of Baits.—There is, of course, no such thing as a poison which will kill rats and mice and nothing else; what is wanted is to reduce the risk as much as possible by using poisons to which rats and mice are peculiarly susceptible. Now the success of a rat poison depends not so much on its actual toxicity as on its being presented in a form that is acceptable to and readily taken by the rodents.

Apart from mere palatability, several points require consideration, such as the size of the bait and the amount of poison in it. A bait should be small enough for a hungry rat to eat it all, and should contain enough poison to kill. If a bait will kill even if only half of it is eaten, so much the better.

Experiments carried out at the Laboratory showed that rats eat about one-tenth of their body weight per diem; hence a bait of 30 to 60 grains is suitable and represents about one-tenth of a day's food supply. Each such bait should contain a lethal dose; to obtain this the following percentages of toxic agent in the baits prepared are used:—

Arsenic 5%	Each bait being about 20 grains.
Barium Carbonate 25%	,, ,, ,, 30 ,,
Squill Bulbs 20%	,, ,, ,, 50 ,,
Squill Powder 20%	,, ,, ,, 25 ,,

Baits should be prepared in such a way that they are ready for use; such operations as spreading on bread, etc., should be avoided. The quantity to be used should be clearly stated in common measures, such as a teaspoonful. It is, however, an advantage to prepare the bait in tablet or biscuit form, as the quantity used and the amount of poison per bait are then easily controlled. The most important point of all is that the bait should be attractive to the rodents, and this can only be decided by experiment and observation in the Laboratory followed by field trials. It is here that the close association of the Factory and Laboratory is specially valuable.

Each poison should be made up in several varieties of bait, so that if one kind is not taken a change can be made. The most frequently used bait is a mixture of oatmeal and fat, to form a hard paste; this is more useful in winter than in summer. Another very useful way is to mix the poison with flour, work up into a dough, and prepare biscuits or tablets, which are then baked. Variety of flavour can be obtained by introducing such substances as grated cheese (the older the better), minced fish or fish meal, and sugar. Baits with no natural odour are slightly flavoured with aniseed or rhodium oil. Differences of opinion exist as to the advantages of this but slight flavourings are generally favoured.

Successful rat destruction depends not only on the choice of suitable toxic agents, made with due regard to their chemical and toxic properties, but also on the adaptability of the baits to the varying tastes of the rat. In England, the rat generally prefers variety, *i.e.*, in a cheesemonger's the best bait would probably

be fish. In India, however, it is found that a bait similar to their usual diet is most successful.

The baits prepared at the Factory are supplied to the various Government Departments, and a few notes on the organisation of this side of the work may be of interest. The Office of Works have three rat officials, who were trained by the Ministry's technical staff. These men work under the direction of the chemist-in-charge, to whom complaints of infestation in the London area are sent. The building is then inspected and suitable treatment applied, the bait being drawn direct from the Factory. Cases of difficulty are referred to the Rat Destruction Branch, when arrangements are made for inspection and advice by the technical staff. Bait is also supplied on application for use at H.M. Office of Works buildings in the provinces; at Admiralty and War Office establishments at home and abroad, and at other buildings and areas occupied by Government Departments. In general the treatment has succeeded in ending the nuisance or greatly reducing it. Many of the buildings treated are in badly-infested areas and continuous efforts have to be made to effect permanent improvement, but even in the worst cases persistent efforts with varying bait, supplemented by trapping, have been successful.

PIGS FOR BACON.

SANDERS SPENCER.

Changes Leading to the Modern Type of Bacon Pig.—The changes which have taken place during the past half-century in the form, weight, quality and degree of fatness of the pigs intended for conversion into bacon, have been equally as extensive as in the pigs intended for consumption as fresh pork.* We might even go further and express the opinion that the so-called bacon curer's pig has assumed a special form and character, markedly distinct from the pork pig.

These changes have been due to various causes, one of the chief of which was the introduction some forty-five years ago of cold air chambers into the bacon factory. These enabled the bacon curer to carry on his trade with the same amount of ease and as little loss during the summer as during the winter months. This in turn made it unnecessary for the slaughtered pigs to carry so great an amount of fat as was needed when the meat had to be heavily salted to keep it sweet during the hot weather. The proportion of fat to lean was also requisite to stimulate the appetite of the consumers, who were not tempted for any length of time by the hard and very strongly salted lean portion of the old-fashioned bacon. This difficulty of the hard and heavily salted lean meat was completely removed by the adoption of the mild curing process which became possible when the necessity for preserving the meat for any considerable time ceased. A continuous supply of fresh cured bacon became available.

Among the other causes for the change in the character, size and weight of the bacon pig was the greatly increased purchasing power of the wage earning classes. With the advent of greater purchasing power came a desire for provisions of better quality, and this was accompanied by a demand for an increased quantity of food. It is quite possible that the consumption of an excessive proportion of the heavily salted old-fashioned bacon with its large amount of fat from old pigs, might have been attended with some inconvenience to the consumer, whereas the mild cured bacon, not so rich and the produce of young pigs, was much less likely to affect injuriously the health of the person dining, not wisely, but too well on it.

A change in the system of living amongst the wage earners and of the lower middle classes was taking place about the same time,

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* See this *Journal*, October, 1921, p. 608.

the one or two hot dinners weekly giving place to more frequent and much smaller daily hot joints, whilst the lump of very fat bacon was giving way to the fried rasher for breakfast in the large majority of cottages and even in those mills where the employees were allowed to cook their breakfasts. This enormous increase in the demand for the middle, the hams and the better portions of the sides of bacon, placed the curers in a difficult position when the large proportion of fat pigs sent to the factories consisted of heavy-shouldered and short-sided pigs, carrying an excess of fat, such as were general in the seventh decade of last century. The heavy and coarse shoulders and the large and fat jowls, formed so large a proportion of the side of bacon, and the demand for them was proportionately so slight, that the curers were forced to start a campaign against the chubby short-sided and over-fat pigs which were so fashionable at that period, largely as a result of the demand from the United States for a pig of that character. This demand must have arisen from a desire for a pig, the complete opposite in form and character of the so-called "rail splitter," then so common on the American Continent, rather than because of the utilitarian properties of the then fashionable pig.

A vigorous campaign was commenced in the agricultural press against the thick pig with heavy head and shoulders and short back. Diagrams of the flesh of the fancy and of the bacon curers' types of pig were published showing the varying proportions of the lean meat and fat meat in their carcasses. Not content with this, one of our largest and best known firms of curers purchased pedigree boars and distributed them amongst the farmers and pig breeders who sent their bacon pigs to the factory. In deciding on the breed of boar for distribution the firm was influenced somewhat by the desire of the producers to breed only pigs dark in colour. The attempt was not an entire success, since the produce of these boars from the local sows proved to be rather heavy in the forequarters and too short-sided.

Danish and Canadian Action.—Meanwhile, the Danish Government had sent to this country one of their officials who was an exceedingly good judge of stock for the purpose of inspecting as many as possible of the English, Irish and Scotch bacon factories, the type of the pigs slaughtered therein, and the herds of most of the successful breeders. After a stay of some months this official reported to his department in Denmark in favour of a certain type of large white pig. Purchases were subsequently made from one large herd, and the pigs were distributed amongst

the principal Danish farmers who were interested in the private and in the co-operative factories. The improvement in the form of the pigs from the native race when mated with the large white boars was so great as to form one of the principal topics of conversation on the chief bacon markets in Britain. One of the largest firms of bacon curers in Canada forwarded an order to their London agent who had been engaged in the shipment of some boars to Denmark to purchase boars and gilts similar to those exported to Denmark. and thus the Canadian bacon which was becoming popular in this country was still further improved.

Improvement of Irish Bacon.—In the meantime the bacon curers in Ireland had not rested on their oars, but had jointly taken steps to improve the form and quality of their bacon, which even then had so high a position on our markets. One of their first steps was to issue a sketch of two sides of bacon showing the position, size and value per lb. of the different joints into which each side was usually divided when sold on the retail market. This gave Irish farmers a clear idea of the kind of pig which would make the highest price on the markets. They even went further, and purchased a number of thick-fleshed, short-legged large white boars of fine quality and distributed them among the pig breeders in the neighbourhood of the different bacon factories. The Dutch were also considerable purchasers of a certain type of large white boar.

Influence of the Danish Trade.—The improvement in the bacon imported from Denmark was so marked that two of the principals of one of our chief firms of bacon curers journeyed to Denmark to ascertain how it had been brought about, and to study the systems of pig feeding general in that country. On their return the firm took immediate steps to purchase nearly two hundred thick-fleshed, lengthy, large white boars of the same type as those exported to Denmark. These boars were exchanged for the old fashioned boars of those who supplied the firm with pigs, and an arrangement was made for the general use of the boars. The results were entirely satisfactory to all parties. The evolution of the present type of bacon curers' pigs has been somewhat fully considered owing to the success which has attended the efforts of pig breeders and bacon curers.

The great improvement in the form and quality, and even in the feeding of the bacon pig, has extended to well nigh all those countries which export bacon to this country. Even Russia, which had begun to send us considerable quantities of bacon. had already imported a number of English pigs for the purpose

of improving their bacon. The bacon curers in America alone appear not to have taken the necessary steps to improve their pigs so that the bacon which they export in such large quantities to this country could compete on fair terms with that which is imported from other countries. One of the principal reasons given by the packers is that it is impossible to get American breeders to pay attention to the feeding of their hogs with a view to improving the quality of the pork. They can grow corn or maize in such large quantities and can feed it to their pigs with so little expense, when labour is so costly, that they are content to produce inferior quality pork, being ignorant or careless of the fact that the production of a better article from pigs longer in the body and carrying a larger proportion of lean meat, would be far more profitable to them and more satisfactory to us as consumers.

Modern Requirements.—When the requirements of the modern bacon curer are carefully studied, they are seen to be by no means of so onerous a nature as to prevent our breeders and feeders complying with them, providing more care and attention be paid to the subject than used to be the case when the pig was of far less importance than at present. About all that is asked of the present day pig owner is that he should make a study of the wants of the consumer and then proceed to supply these wants in a business-like manner.

Most of the needs of the consumer of bacon at present are comprised in the following particulars:—The bacon must carry only a comparatively small proportion of fat to lean; it must be of fine quality, *i.e.*, the skin and the bone must be fine and the flesh free from coarseness; the joints must be of comparatively small size; and in order to conform to the two last qualifications the fat pig must be liberally fed on suitable food all its life, which must be a short one.

Length of Body.—As to the formation of the pig best suited for the manufacture of such bacon, it should be long in the body, so that as large a proportion as possible will consist of the middle which realises the highest price of any part of the side.

The hams should be long and well developed down to the hock, so that the proportion of bone to meat will be small and the ham shapely.

The flank should be thick, as this is a sure indication that the pig carries a large proportion of lean to fat meat.

The shoulders should be light, as this portion of the sides is in limited demand and realises a lower price than either the middle or hinder portion of the side.

The legs should be short and the bone of fine quality, as this is held to be

an indication of the quality of the meat, whilst a pig which is long on the leg is generally coarse in the bone and usually far from restful and contented.

The jowl should be light, as its market value is limited, whilst a large head is generally associated with a heavy and a somewhat coarse body, a long head frequently indicating the opposite, with a limited aptitude to fatten.

Hair.—As to the kind and quantity of hair which a pig suitable for the bacon curer should possess, there is a diversity of opinion. In Cumberland and certain parts of the province of Ulster a pig with comparatively little hair is preferred, whereas in most other parts of the British Isles a covering of fine silky hair is sought after, on the ground that pigs which are sparse of hair are frequently deficient of lean meat. Generally speaking, straight hair is preferred to curly hair, as pigs possessing the former are considered to furnish meat of a finer grain. This view is not held in Lincolnshire, the home of the curly-coated pig, but this may arise from the fact that the demand in Lincolnshire is for a class of bacon different from that required in most parts of the kingdom. The pig with harsh and coarse hair is not now a favourite in any part of the country, as it invariably fattens slowly and furnishes pork of an inferior quality.

Quick growth and early development are particularly necessary in the bacon pig, as bacon manufactured from young pigs is greatly preferred, and there is a great advantage to the feeder, the quantity of food consumed for the mere upkeep of the pig, body heat, locomotion, etc., being much reduced and its cost saved.

Colour.—Another point which is considered of some importance by many curers is the colour of the pig slaughtered, white sides of bacon having a nicer appearance than black ones. Some bacon curers encourage their buyers to send in white pigs for slaughter by offering sixpence per head more for white than for coloured pigs. Some few years ago the writer was at a factory in Ireland where one thousand pigs were slaughtered in one day, and after careful inspection failed to find a single coloured pig, so that on one day alone this firm would be paying about £25 in order to secure pigs of a white colour. The extra cost during the year would therefore be some thousands of pounds, showing the incorrectness of the assertion that the preference for white pigs is only fancy.

Feeding.—One other requirement on the part of the curer is that feeders should be careful to supply such food to their pigs as will produce pork of good quality which can be converted into firm bacon with lean of a nice colour. This may make a difference of several shillings per cwt. in the market value of the bacon, and the extra cost of the more suitable food may make little or no monetary difference to producer of the pigs. An excessive proportion of potatoes, of maize, or of sharps in the ration results in the production of soft and oily bacon, which wastes much in cooking; an excess of beans or bean meal makes the lean portion of the bacon hard. Some curers also complain of the use of fish meal in the feeding of pigs, on the ground that the bacon from pigs so fed is

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apt to have a fishy flavour when cooked. So far as has been ascertained this unpleasant flavour is the result either of using an excessive quantity of fish meal or meal of an inferior quality, *i.e.*, meal made from other than white fish and containing too large a proportion of oil. In recent years the various kinds of food suitable for pigs have increased so greatly in number that there can be no excuse for neglect in using the few foods which are less suitable for the production of pork of fine flavour and quality.

Breeds.—The choice of pigs of different breeds which are said to be suitable for the production of bacon has enormously increased of late years. Breeders of Large Whites, Large Blacks, Essex and Wessex Saddlebacks, Gloucester Old Spots, Tamworths, Cumberlands, Ulster Whites, Lincolnshire Curly Coated, &c., all declare their belief in the exceptional suitability of their favourite pigs for the manufacture of the finest qualities of bacon. These beliefs may have the best possible foundation, but some of the breeds may not have been in existence for a period long enough to have afforded quite so great a proof of their suitability as might be desired. At the present time many thousands of pigs, which are crosses from the Large White Boar and the Large Black Sow, are slaughtered weekly by the bacon curers. This combination appears to give general satisfaction to the bacon curers and to pig breeders and feeders. The Cumberland pig has long been noted for its fine hams, whilst the good proportion of lean to fat meat furnished by the Berkshire and the Tamworth is well known, all these breeds having been before the public for many years. Pigs of the other breeds named may in due course prove their suitability for the production of bacon.

WINTER FEEDING OF LIVESTOCK WHEN ROOTS ARE SCARCE.

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STOCK feeders this year have been faced with a somewhat difficult problem, *i.e.*, how to provide for the winter feeding of their stock. The abnormal season has resulted in a general shortage of roots, and owing to the long-continued drought, green crops drilled during the summer months have either failed to come through, or have been killed after germinating. The writer is aware of one case, where white turnips have been drilled three times and have then failed to yield a crop. In addition to this, in many districts the hay crop is short, as little as 10 tons being taken off 50 acres. There are three conditions that have to be provided for this year:—

(1) Farms where both roots and hay are short.
(2) Farms where roots are short but hay and straw are moderately good.
(3) Where roots are short but straw is plentiful. This is generally the position in the Eastern Counties.

Farmers have mainly faced the difficulty by keeping less stock, and in the case of sheep flocks, by reducing their ewe flock, fattening off and marketing their ewes. The markets have lately been fairly full with 2, 3 and 4-shear ewes intended for the butcher. This is perhaps the easiest way out of a difficult position, but the farmer who chooses this course will be selling his ewes in a cheap market with the prospect of buying later at a dear rate. It may therefore be opportune to discuss the general problem involved, and to see whether, after all, it may not be possible to adopt an alternative solution.

Where both hay and roots are short (case 1), a reduction of the number of stock kept must be effected unless a certain amount of straw is available, when the conditions approximate to those of case 3, and the same general rules laid down there can be followed. Hay and straw are necessary for cattle, sheep and horses. These animals require a certain amount of bulk in their food which can only be supplied by hay or straw. In the case of cattle and horses, about 14 lb. of rough fodder per day is absolutely essential for the animals' well being; any attempt to go below this will, especially in the case of cattle, lead to discomfort and general restlessness and unthriftiness. In Germany, where

it is common for the farmers to experience a shortage of rough fodder, it is a common practice to supplement the hay and straw available with the leaves and small twigs of beech, birch and poplar, and similar broad-leaved forest trees. Leaves of trees gathered towards the end of July have a feeding value equal to that of medium meadow hay.

In the case of sheep weighing about 100 lb., 13 lb. of dry matter is required weekly to keep the animal in good condition, and in general practice, where plenty of roots are available, a part of this dry matter is supplied by roots, the average ration of hay for sheep generally being about 5 lb. a week, with roots *ad lib.*

The average requirements of farm animals for coarse fodder, (hay or straw) is therefore as follows :—

	Live weight.		*Fodder as hay or straw.*
Horses	8 cwt.	...	13 lb. per day.
	12 cwt.	...	17 lb. ,,
	16 cwt.	...	20 lb. ,,
Cows and bullocks	9 cwt.	...	14 lb. ,,
	12 cwt.	...	17 lb. ,,
Sheep	100 lb.	...	15 lb. per week.
	140 lb.	...	19 lb. ,,
Pigs	All weights	...	Nil.

The requirements given above are the *physiological* requirements of the animals, and although in most cases they correspond with actual practice, they are not based on the results of practice but on a study of the structure and capacity of the digestive tracts of the animals mentioned. Although the *minimum* requirements given above for horses are the same as those for cattle of equal weights, the actual capacity of cattle to deal with coarse fodder is much greater than that of horses. This is shown in practice. The amount of coarse fodder given to horses is approximately constant, but the nature of the fodder given varies according to the nature of the work the horse is required to perform. Thus with horses at rest good oat straw or oat and wheat straw is considered good enough, but when the horse is required for hard work the greater part of the straw is replaced with meadow or clover hay. In the case of the racehorse the diet consists of the finest quality meadow hay and the best oats procurable.

In the case of cattle, on the other hand, the capacity to deal with coarse fodder goes well beyond the minimum requirements given above, and the same argument applies to a lesser extent to sheep. The pig, however, owing to its comparatively simple digestive tract, cannot deal with coarse fodder to any extent and

its food therefore rarely contains much fibrous material. For this reason, too, silage is unsuitable for pigs intended for fattening, although perfectly suitable for breeding stock.

With regard to roots, these are fed normally to cattle and sheep and occasionally to horses and pigs. They are, however, chiefly used for cattle and sheep, and it is for these animals that the question of rationing in the case of a shortage becomes a serious problem. Roots are watery feeding stuffs containing sugars and starchy material chiefly, with but very little fibre.

Use of Molasses.—Sugar cane and beet molasses consist of sugar residues, amides and no fibre, and are therefore approximate to roots from the feeding standpoint, in the nature of the food material supplied. One ton of molasses is approximately equal in feeding value to 6½ tons of roots, but owing to its peculiar laxative properties cannot be fed to cattle to anything like the extent that roots can. Thus the limit for feeding molasses to farm animals is as follows:—Horses up to 3 lb., cows 2½ lb., bullocks 4 lb., and sheep ¼-½ lb. per head per day. Pigs as a general rule do not do well on molasses, and its use for them is not advocated.

The general solution of feeding problems in cases where roots are scarce resolves itself into a question of feeding more hay or straw and utilising molasses to replace part of the roots, and feeding more concentrated meals, cake and corn to make up the deficiency in the ration. It will be seen from the statement above that molasses can only be regarded as a substitute for roots to a limited extent. Molasses has the great advantage that it is laxative in effect, is a general appetiser, and is much appreciated by stock. The maximum benefit of molasses is consequently obtained by using it with straw and inferior quality hay. This enables the stock-feeder, in the case of a mixed stock farm, to reserve his best hay entirely for his horses or his ewe flock.

Method of using Molasses.—(1) When used with straw, the molasses should be dissolved in warm water, thrown over the straw, well mixed and allowed to ferment for 12 hours before feeding.

(2) The measured quantity of molasses may be mixed directly with the food, or be placed in the trough on the top of the food. Dairy cows will eat molasses given in this form quite greedily.

Objections to Molasses.—The chief objection to molasses is due to its stickiness and difficulty in handling. For this reason, proprietary foods are available for the use of farmers who may prefer to get their molasses in this form. Such foods consist of

molasses soaked up in an absorbent such as spent hops, tapioca meal, soya bean meal, sugar cane pith, apple pomace and sphagnum moss. The chief disadvantage to the use of such foods is that the absorbent used replaces a part of the straw that would otherwise be consumed. Fed in such a way, too, the molasses is more expensive to buy, and the farmer must decide for himself whether the advantage gained in ease of handling compensates him sufficiently for the extra cost.

The Jonas Method of treating Straw to make it Palatable.—An alternative method of making straw palatable to stock and so conserving hay supplies is that adopted by a Mr. Jonas some 50 or more years ago. This method consisted in chaffing the straw when the corn is threshed in the spring, and mixing with the chaff a green forage crop in the ratio of about 1 cwt. of green crop per ton of straw. At the same time salt is added. As a result of this treatment a slow fermentation process is set up, and the cattle eat with avidity such chaff when fed in the winter months.

Putting the above principles into practice the writer suggests the following rations as being suitable for root shortage conditions. It is realised that such suggestions are general and may not fit individual cases, but every effort has been made to provide for every case likely to arise in farming practice. Any reader whose particular problem still requires solution is advised to write in the first place to the Agricultural Organiser for his County or, in the case of counties still without an Agricultural Organiser, direct to the Ministry.

Sheep.—In the case of sheep, the root shortage, and failure to grow forage crops present a serious problem. Normally, sheep will eat approximately 16 lb. of roots per head per day, and will get in addition about ¾ lb. of hay and a similar quantity of corn or cake. In the case of a root shortage, the hay ration should be increased to 2¼ lb. per head per day and if hay is also scarce, oat straw may be substituted for the hay. In these circumstances a typical ration for sheep weighing 100 lb. will be :—

Per week.

A.	8 lb. hay, 7¾ lb. oat straw.	or B.	15 lb. hay.
	22 lb. swedes or kohl rabi.		22 lb. swedes.
	5 lb. cake and corn.		5 lb. cake and corn.

When the roots have failed altogether, a forage crop of some sort will generally have been drilled and either mustard, rape or white turnips will be available. In the absence of any of these fodder crops, the sheep can be comfortably wintered on hay,

straw and corn alone, their corn or cake ration containing linseed cake and crushed oats. In normal practice, the danger to the ewe flock is loss of lambs due to too heavy root feeding, and the writer is convinced that a normal crop of lambs can be produced even in the absence of roots or with a shortage of green forage. The hay and straw chaff will be more readily appreciated if a little treacle, suitably diluted, is sprinkled over it.

Horses.—Horses will not present a problem, because roots are not normally fed to these animals.

A heavy draught horse will require per day, 1½ stone of either hay or straw chaff or both, together with 7 lb. of oats for light work; 11 lb. of oats for medium work or 16 lb. of oats for heavy work. Further particulars of feeding stuffs suitable to substitute for oats are given in Miscellaneous Publication No. 32,* and the appended table giving the quantities of other feeding stuffs, which may be regarded as equivalent in feeding value for horses, is taken from that publication.

	Amount equivalent to 10 lb. oats.		*Amount equivalent to 10 lb. oats.*
Maize	7·3	Linseed cake ...	8·0
Grain	10·0	Barley	8·3
Beans	9·0	Dried brewer's grains	12·3
Palm kernel cake ...	8·0	Pollards	9·9
Gluten feed	7·9	Bran	13·2

At present prices it pays to feed oats only, but in cases where oats are short the above feeding stuffs may be utilised to replace up to one-half of the oat ration.

Cattle.—In the case of fattening cattle, and for cows of 9 cwt. yielding 1 gallon of milk per day, the following rations are suggested, bearing in mind:—

(1) Farms where silage is available.
(2) Farms where a limited amount of roots are available.
(3) Farms where neither silage nor roots are available.

A.	B.	C.
lb.	lb.	lb.
1 Treacle.	½ Treacle.	10 Seed hay.
5 Wheat chaff.	5 Wheat chaff.	5 Oat-straw chaff.
26 Silage.	26 Silage.	5 Wheat chaff.
40 Roots.	20 Roots.	5 Maize meal.
5 Hay.	5 Oat-straw chaff.	
	4 Cotton cake.	

* Obtainable from The Secretary, Ministry of Agriculture and Fisheries, Publications Branch, 10, Whitehall Place, S.W. 1, price 6d. post free.

PREVENTION OF BUNT AND SMUT.

THE year 1921 stands out as remarkable for the early ripening of wheat. Though the season suited few crops, it suited wheat, and during the month of July crops of good quality were anticipated.

In spite of this promise, however, a rude shock was experienced by unwary farmers at harvest by the discovery that Bunt or Stinking Smut was present and had ruined a large portion of the crop. It cannot be too strongly impressed upon the growers that **the bunt developed because the seed grain had not been properly pickled; if it had been dressed with Formalin as advised by the Ministry, such disappointments would not have occurred.**

Everything that is possible should be done to prevent such losses, the more so because the price of wheat is still falling. It should be clearly understood that Bunt and also the allied diseases, Loose Smut of Oats and Covered Smut of Barley, *can be thoroughly controlled.* The most wideawake farmers realise this and regularly use either the Formalin treatment or the older, but less satisfactory Copper Sulphate method. To all who are concerned in growing cereal crops the Ministry recommends the perusal of Leaflets Nos. 92 (*Bunt and Smut in Wheat*) and 328 (*Smut in Oats and Barley*), whilst for fuller details as to Bunt control the excellent article by Professor E. S. Salmon in this *Journal** should be studied.

It may be worth while to record some of the actual figures as to infected crops received by the Ministry during the past two seasons, showing the appalling loss farmers incur by the neglect of pickling.

Omitting the minor cases, such as those in which 5 per cent. of the crop is infected, which are very general, the following may be instanced:—25 per cent. in Herefordshire, 35 per cent. in Shropshire, two cases of 40 per cent. in Cambridgeshire; in a 9-acre field in Lancashire 4 acres were attacked to the extent of 40 per cent. and the remainder 20 per cent.; in another Lancashire field 55 per cent. was attacked; 40 per cent. in a 7-acre field in Gloucestershire; 40-50 per cent. in Lincolnshire; whilst in some portions of badly attacked fields 70 per cent. was the figure given. A final case just to hand may be cited. In a northern county a chance sheaf of wheat was taken from the binder and the ears counted: 525 were found affected with Bunt and 565 free, *i.e.* 48 per cent. of the wheat was infected. Many

* This *Journal*, February, 1921, p. 1013.

of the above figures were derived from actual counts of carefully selected samples, the others were from estimates made by competent persons. When it is remembered that affected ears are totally destroyed, the lamentable waste involved is obvious.

The Smuts of Barley and Oats play similar havoc with the two cereals involved, and *in this case again, careful pickling with Formalin will reduce the disease to practically nil.*

Treatment for Bunt.—The Ministry strongly recommends the use of Formalin, which can be purchased from any chemist. Careful experiments carried out at Wye showed that Formalin

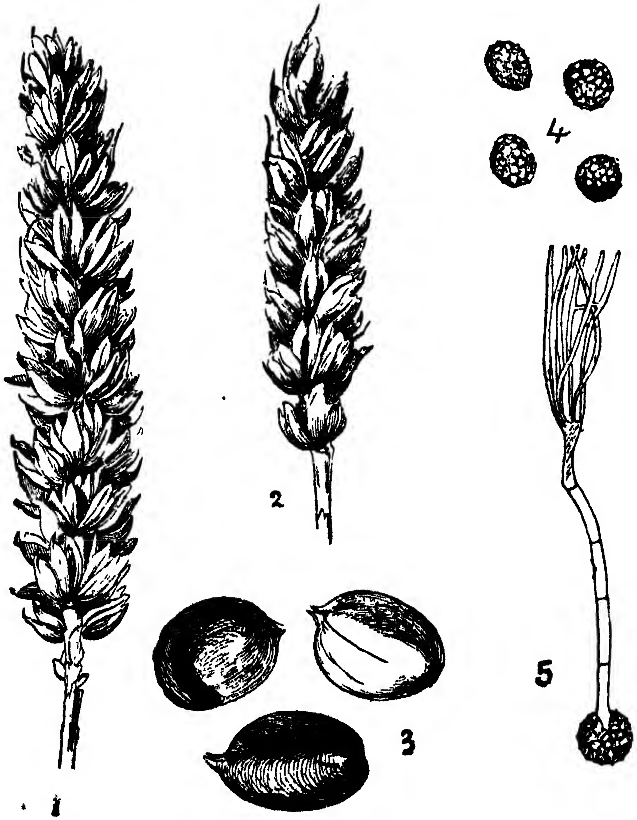

FIG. I.—Bunt.
(1 and 2) Bunted ears. (3) Spore-containing grains.
(4) Spores of Bunt (*Tilletia tritici*). (5) Spore germinating.

was found to be superior to Copper Sulphate, as with it it was possible to obtain absolute control of Bunt with less injury to the grain.

Formalin is easy to use and gives complete control. Formalin

(a 40 per cent. solution of formaldehyde) should be used at the rate of 1 pint to 40 gallons of water (½ fluid ounce or one tablespoonful to the gallon), care being taken to stir well while mixing. The solution should be sprinkled over the seed and the heap repeatedly turned over till all the grains are wetted. It will probably be found that two gallons of the solution are required to wet four bushels of wheat, but in no circumstances should the solution be allowed to form pools under the heap, in which the grain might soak, or germination may be reduced. After shovelling, the grain should be placed in a heap and covered with sacking moistened with the Formalin solution and left covered for four hours. After that time it should be spread out to dry and then sown as soon as possible. Precautions should be taken that the wheat is not re-infected after pickling by being placed in sacks which have held infected corn, or on a contaminated floor in a barn.

Treatment for Barley and Oat Smuts.—To make the solution 1 pint of commercial Formalin should be poured into 20 gallons of water and mixed thoroughly.* The grain may be sprinkled with the solution, or steeped in it. For sprinkling it should be placed in a heap on the floor and the solution should be poured over it at the rate of 1 gallon to every four bushels. The heap must be turned over repeatedly so as to moisten every grain and should be covered over with sacking damped with the solution for four hours, as recommended for wheat. If the steeping method is preferred the grain should be soaked in the solution for ten minutes, stirring it thoroughly meanwhile in order to be certain that every grain is wetted. Infected grains which float to the surface should be skimmed off. It should then be placed in a heap for four hours and covered with sacking.

After four hours the treated grain should be spread out in a thin layer to dry, and then be sown as soon as possible. If it is necessary to store the grain care should be taken that it is not re-infected by being placed in smutty bags or on smutty barn floors.

* A still more dilute solution—1 pint in 30 gallons—has given excellent results in trials. See Salmon and Wormald, this *Journal*, March, 1918, p. 1388.

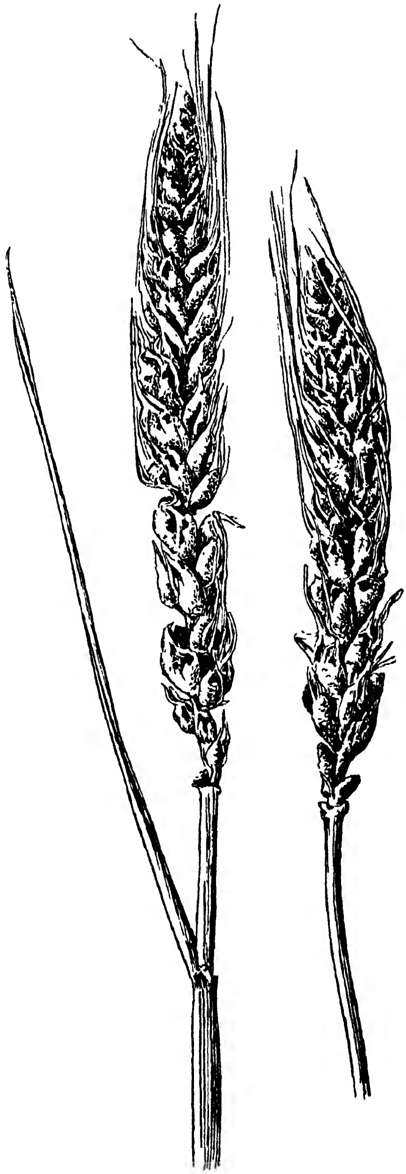

FIG. 2.—Covered Smut of Barley.

FIG. 3.—Loose Smut of Oats.

PIG AND POTATO CLUBS IN GLOUCESTERSHIRE.

G. H. HOLLINGWORTH.
Hon. Organising Secretary, Gloucester County Pig and Potato Production Committee.

IT may be observed that there is nothing new in the idea of pig clubs in Gloucestershire. They existed long before the War, chiefly on the Cotswold Hills, and stand out as notable examples of independent thrift displayed by agricultural workers in Cotswold villages, at a period when wages were low and the families of farm labourers received little fresh meat apart from the pigs they fed and killed. To lose a pig in those days was a serious matter—it almost spelt ruin in some cases—and a scheme for mutual insurance which had a great deal to commend it was therefore established by the village labourers. In other words the cottage pig-keepers formed themselves into clubs for the mutual insurance of their pigs. The small premiums were paid into a common fund which in some cases was augmented by donations from farmers and other sympathisers, and the headquarters of the club was generally the village inn. The rules of the club were few and simple, and if a member was so unfortunate as to lose an insured pig, he was fully or partly compensated, according to the rules and the financial status of the club. From the point of view of insurance business, the establishment of village pig clubs was as risky as it was primitive, and if losses occurred before a reserve fund was built up the outlook became serious. Fortunately, however, the hill-bred pigs were healthy and fatalities were not numerous. The objects of the insurance club were thrift, and to obtain that sense of security which insurance gives. Through having to pay out little for compensation, some of the older clubs have built up reserve funds amounting in some cases to hundreds of pounds. The story of Gloucestershire pig clubs in the past is one that does infinite credit to the thrift and economy of a class of workers which was poorly paid, and in this way demonstrated the value of co-operation and mutual self help.

Pig and Potato Clubs as a War Measure.—It was in the spring of 1918 that the county scheme, as at present con-

stituted, was set on foot at the instigation of Lord Bledisloe, K.B.E., for the primary object of encouraging the production of pigs and potatoes at a time when the national outlook for food, particularly meat and fats, was very critical. Lord Bledisloe contributed £500 towards a capital fund, similar amounts were provided by Lt.-Col. Sir H. Webb and Messrs. R. Thomas & Co., and with smaller contributions made up a total of over £2,500, the interest on which is used for working expenses. Lord Bledisloe can justly claim to be the founder of the scheme and Mr. Robert Gray, who is greatly interested in the welfare of rural workers, has been chairman of the county committee since its inception. It was agreed at the outset that the objects of the scheme could be best achieved by enlisting the co-operation and help of existing pig clubs, and by forming others for the following purposes:—(1) To encourage and assist as many people as possible of the cottager class to keep pigs. (2) To utilise all spare and waste produce for pig feeding and co-operate in the purchase of feeding stuffs. (3) The insurance of pig keepers against loss by payment of a small premium. (4) The co-operative purchase of Scotch seed potatoes for gardens and allotments.

The decision of the committee was followed by action, and after a few weeks' campaign of public meetings in villages, upwards of a hundred local clubs were formed and affiliated to the central committee. Most of these clubs required working capital to enable them to purchase feeding stuffs, and while in some cases this was provided out of the capital fund at a low rate of interest, in others the money was advanced by local well-wishers.

Club Rules.—A set of model rules for the use of affiliated clubs was drawn up by the county committee, which is composed mostly of representatives of local clubs, and though the latter are under no obligation to adopt the model rules in their entirety most of them have done so. Outstanding clauses in the rules are, first, the objects of the club, namely (a) to afford means by which members may, upon strictly mutual principles, insure against loss of their pigs through disease, accident or other cause, (b) to secure for members' pigs the best conditions for their health and profitable keeping, (c) to purchase pigs and feeding stuffs on co-operative lines, (d) to encourage the cultivation of potatoes and other crops for human and pig consumption. Each local club defines its own area, appoints its own committee and officers, becomes responsible for its

own finances, and pays to the county committee an annual affiliation fee of 2d. per member with a minimum of 2s. 6d.

Insurance Premiums and Compensation.—A large amount of the business of local clubs is connected with insurance. The rules provide for the appointment of two or more inspectors whose duty it is to inspect and approve all pigs before they are accepted for insurance. The inspectors have also to inspect and report on pigs in cases of illness or death within 48 hours after receiving notice. In the case of a sick pig the inspectors may also decide whether the pig shall be killed or treated by a veterinary surgeon. Two classes of pigs are accepted for insurance under the rules:—Class A—Store pigs, the premium payable on these being 2s. 6d. per head from 8 weeks old until they are killed or sold, up to a value of £15. Class B—Breeding sows and boars, the premium for which is 10s. per head per annum up to a value of £20. The secretaries of affiliated clubs must send at the end of each month to the secretary of the Gloucestershire Pig and Potato Production Committee, a list of the pigs insured during the month, together with half the amount of the premiums, in return for which the county committee becomes responsible for two-thirds of the amount of the compensation payable in the case of a loss, the compensation payable to the owner of the pig being at the rate of four-fifths of the assessed value or 16s. in the £. When an insured pig dies or has to be slaughtered, the inspectors report the matter to the club committee, who examine the facts with a view to assessing the amount of the compensation, which is based on the value which the pig would have realised in the market before its death. In the event of the carcass or part of it being sold for any purpose, the amount realised is deducted from the sum payable in compensation. It will be observed from this that the insurance scheme is mutual in two ways. In the first place members of local clubs contribute one-third of the compensation which the club has to find in the case of a loss, and secondly, clubs help each other in providing through the county committee two-thirds of the compensation for which this body is responsible. Since the scheme was established in 1918, and down to 31st March, 1921, over 11,000 pigs belonging almost entirely to cottagers have been insured, and the share of the compensation paid out by the county committee in respect of pigs that have died amounts to nearly £500. This represents the loss that would have been suffered by the owners of the pigs if no insurance scheme had been in existence.

Some of the Results.—Prompted by motives of patriotism and self-preservation many people started pig-keeping in 1918 who had not hitherto done so, and while it was unfortunate that in consequence of the War the position as regards animal feeding stuffs became very serious, it is safe to say that the co-operative organisation provided by pig clubs was the means of preventing many pigs from being slaughtered prematurely. Further, through the pig club movement during the War, the county played a creditable part in the production of food at a time when it was badly needed. It was inevitable that when peace was restored some of the clubs which were started and run largely as War measures by patriotic people would cease their operations, and the movement has been checked somewhat by the high cost of store pigs and the prohibitive price of material for building pigs' cots. Nevertheless, the efforts of the county committee to continue their operations on a peace-time basis are fully justified, and at the end of the financial year, 31st March, 1921, there were 63 local clubs affiliated to the county committee. During the year 3,214 pigs were insured, of which 56 died, and the amount of compensation paid out of the committee's fund was £206 17s. 5d. The Cotswold Hills remain true to their traditions in the matter of pig clubs. The older clubs are still vigorous and progressive, many new ones have been started and they are mostly run as pig clubs should be, by the benefitting members, *i.e.*, the cottage pig-keepers, without outside help or patronage, and it is only in this way that any real spirit of co-operation can be maintained. It is hopefully anticipated that, with a return to more normal conditions in the value of pigs and building materials, pig-keeping will be increased amongst cottagers and the sphere of good work accomplished by the village clubs developed. This is all the more desirable in view of the general increase of allotments, the supply of animal manure for which is one of the problems that has now to be faced. The allotment holder who has one or two pigs on his plot solves the problem for himself, for while the pigs provide him and his family with wholesome food, they also maintain a supply of manure for the benefit of the vegetable crops grown on the allotment. To realise this one has only to inspect the plot of a pig-keeping allotment holder.

Local Competitions and Challenge Cups.—In a number of cases prizes are offered by local clubs for pigs kept by the members, and in 1920 Lord Bledisloe kindly presented two

silver challenge cups for competition amongst affiliated clubs; the trophy to be held for the year by the club which provided evidence of having best furthered the objects of the scheme in the following directions:—

1. Membership of the club for the year concerned.
2. Approximate population of the district served by the club, if obtainable.
3. Total number of pigs insured under the county scheme for the year.
4. Particulars of arrangements made by the club for supplying members with feeding stuffs on co-operative lines. Methods adopted of growing food for pigs should also be described.
5. Efforts the club has made to encourage the breeding of pigs.
6. Particulars of any effort made to purchase seed potatoes on co-operative lines for members.
7. A general account should be given of the operations of the club, *including any special features of interest*; also a statement of accounts which will enable the judges to form an opinion as to the financial position of the club and the methods of keeping accounts and general management.

Down to the present the challenge cups have been won by the Sherborne and Windrush Pig Club, the Maisemore Pig Club, and Messrs. Price, Walker & Co.'s Employees' Pig Club, Gloucester. In the case of the last-named club and also the Gloucester Carriage & Wagon Works Employees' Pig Club, the pigs are kept collectively, shares in the club being held by the members, among whom the pigs are divided as they become fit for slaughter.

Co-operative Purchase of Scotch Seed Potatoes.—Since its inception the movement has done much to increase the production of potatoes on allotments and in cottage gardens, as it provides a means by which small growers can obtain genuine Scotch seed potatoes on the same terms as farmers and large cultivators. The method of procedure is as follows. Seed potatoes of selected varieties are bought in Scotland by the county committee on the most favourable terms, and the secretaries of affiliated clubs are furnished with a list of varieties and prices. Members of the clubs are invited to place their orders, which are bulked, and a small amount is added to the quoted price to cover the expenses of distribution. The benefits of this scheme to individual members of clubs are two-fold. Firstly, by planting fresh Scotch seed the grower greatly increases his crop of potatoes without any addition to his outlay for manure and labour. Secondly, he buys his seed potatoes at wholesale rates, plus a small amount to cover working expenses: this is a great consideration when the figures are compared with retail prices. It

may be mentioned incidentally that since the scheme was inaugurated, about 250 tons of Scotch seed potatoes have been distributed by the Committee amongst cottagers and allotment-holders in the county. In several cases artificial manure has been supplied in the same way, and there is scope for considerable development in this direction.

Except for clerical assistance at headquarters, the movement is entirely a voluntary one, and great credit is due to the affiliated club secretaries who willingly give their services. At a moment when increased production is a matter of prime importance, and also bearing in mind the enormous area of land now under allotments, the advantages of organising pig and potato clubs on the lines adopted in Gloucestershire are obvious to those who realise the benefits of co-operation and mutual self-help.

INSPECTION AND CERTIFICATION OF GROWING CROPS OF POTATOES IMMUNE TO WART DISEASE.

In pursuance of the policy which the Ministry has adopted for the control of Wart Disease of potatoes, arrangements were instituted in the summer of 1918 for the inspection and certification as true to type, of growing crops of potatoes immune to wart disease. The object is to secure for growers having land infected with the disease an adequate supply of " seed " potatoes of immune varieties, reasonably free from rogues. The importance of securing seed which is true to type and free from rogues for planting in infected land is obvious, since the planting of susceptible " rogues " is bound to lead to the reappearance of the disease, with a resultant loss of crop, and may possibly tend to weaken the faith of the growers in the immunity of the varieties recommended by the Ministry. Reports relating to the inspections for 1918 and the following seasons have appeared in previous issues of this *Journal*. The following notes show briefly the extent of the work and the results obtained during the season of 1921.

The inspections are carried out by a specially trained staff selected from the ranks of the Ministry's Inspectorate. Each officer authorised to inspect and certify a crop is first of all selected on account of his intimate knowledge of potato growing, and this corps of selected inspectors is taken to the Ministry's Trial Grounds at Ormskirk in July each year for a " Refresher " course. At the trial grounds, plots of all the immune varieties, new and old, are seen growing, and after two or three days spent in studying the newer varieties and refreshing their knowledge of the older ones, the Inspectors are required to undergo a very severe test of their knowledge. They are called upon to examine and identify no fewer than 24 varieties of potatoes, and to indicate what " rogues," if any, are present. No Inspector is allowed to undertake the work of certification unless he attains a very high standard in this test, and a few of those who attain full marks are appointed to act as " umpires " when occasion arises. The need for " umpires " will be realised by those acquainted with the varying characteristics of the potato crop. Cases arise, moreover, in which the grower is not satisfied with the decision of the Inspector who is instructed not to grant any certificates for

crops that do not reach the high standard of 99.5 per cent. purity, and in such cases the crop is inspected by the umpire. The Ministry is confident that a study of this scheme will show that every reliance may be placed on the value of the certificates issued, and hopes that traders will restrict their dealings in immune seed potatoes to these certified crops.

Prior to 1921 the inspections were carried out free of charge to the grower. The straitened conditions of the national finances, however, caused the Treasury to issue an instruction to the Ministry that all services such as this should only be carried out on a self-supporting basis, and the Ministry was compelled to intimate to growers that a charge would be made in respect of all crops inspected this year. This charge was fixed at the low figure of 2s. 6d. per acre, with a minimum charge of 10s. It is satisfactory to relate, bearing in mind the slump in the potato trade, that applications were received for the inspection of no fewer than 6,170 acres, which is practically the same as the area inspected in 1919, though it is, of course, much below the figure for the "boom" year of 1920.

Judging from the applications for inspection, the most popular of the immune varieties are the following:—Kerr's Pink, Great Scot, Majestic, Ally, Arran Comrade, and King George. The complete list of varieties inspected is shown in the following table:—

Variety.	Acreage Certified.	Variety.	Acreage Certified.	Variety.	Acreage Certified.
Abundance and Abundance Types ...	22½	Dominion ...	¼	Langworthy ...	7½
Adirondack ...	½	Early Market...	6½	Leinster Wonder	¼
Ally	375½	Early Pink Champion ..	¾	Lochar ...	144¾
America ...	6	Edzell Blue ...	12¼	Majestic ...	475¼
Arran Comrade	341	Flourball ..	5¾	Mr. Bresse ...	½
" Rose ...	20	Golden Wonder	19¾	Nithsdale ...	5
" Victory ...	43¼	Great Scot ...	1,378	Rector	½
Ashleaf (Sutton's)	7¾	Heather Bountiful	3	Rhoderick Dhu	8½
Bishop	28½	Irish Chieftain	12½	Schoolmaster...	¼
Burnhouse Beauty ...	1¼	Irish Queen ...	2¾	Shamrock ...	¾
Capt. Cook ...	½	Jersey Royal ...	3	Snowdrop ...	43¼
Climax	½	K. of K. ...	2½	St. Malo ...	¼
Crusader ...	3½	Katie Glover ...	½	Templar ...	121½
Dargill Early ...	68½	Kerr's Pink ...	1,582	Tinwald Perfection ...	166¾
		King George ...	286½	White City ...	2

The exact figures are not yet available, but at the time of writing, over 5,000 acres have been found to reach the very

high standard of purity demanded by the Ministry, and certificates have been definitely refused for only 400 acres.

The Inspectors' reports show that in some varieties (Ally, Great Scot, and Majestic) many crops are still badly mixed, the chief rogues found being Up-to-Date in Abundance crops, and Arran Chief and British Queen in Ally, whilst King Edward frequently appears in the Majestic crops. More trouble is, however, caused by the distribution of wrong stocks, somewhat resembling the variety whose name it bears. There has been distributed under the name of Kerr's Pink a stock bearing considerable resemblance to that variety. The stock differs from Kerr's Pink, however, in that it is susceptible to Wart Disease. Its proper name is not known, and it may be an un-named seedling. There are also two stocks of K of K. in circulation, though one only is correct.

A register is being compiled of the growers with certificated crops, which it is hoped to publish early in November.

THE WORLD'S POULTRY CONGRESS.

THROUGH the enterprise of the Dutch Government the first World's Poultry Congress was held at The Hague from the 4th to 15th September. The conception of the World's Poultry Congress originated from the International Association of Poultry Instructors, an Association created by Mr. Edward Brown, F.L.S., who is its first President. This Association is intended for those who are teachers or investigators in poultry keeping or who are otherwise doing work for the development of the poultry industry.

Arrangements for the holding of a Poultry Congress had made considerable progress at the time of the outbreak of War in 1914, but naturally had then to be postponed. Subsequent to the Armistice Mr. Brown got into touch with the Dutch Authorities, who decided to hold the first Congress at The Hague and to issue official invitations to other nations to send delegates. National Committees were set up in many countries, including Great Britain and Ireland, America, France, Belgium, Spain, Denmark, Italy and Norway. The National Committee for Great Britain and Ireland proceeded to make arrangements for finance, contribution of papers, and a display of poultry, while guarantees of financial support were obtained from private individuals and contributions to the general expenses of the Committee were made by the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the Irish Department of Agriculture and Technical Instruction.

The Committee decided to invite tenders from British and Irish breeders for the privilege of exhibiting a pen of their birds at The Hague Exhibition. There was a good response to this invitation and some 75 pens of birds, including all the principal breeds, were accepted. Some 11 papers were also contributed by British representatives.

It was hoped that educational exhibits illustrating the educational work done and the general development of the poultry industry in the United Kingdom might have been made, but owing to lack of money neither England nor Scotland was able to prepare an exhibit of this character. The Irish Department of Agriculture, however, organised an admirable educational exhibit showing the progress of the Department's work in connection with poultry keeping during the past 20 years,

and setting forth the great expansion of poultry keeping in Ireland during that period.

The organisation of the British display and the necessary arrangements for the British party involved much heavy work, which fell almost entirely upon Mr. T. R. Robinson, the Honorary Secretary, who was greatly helped by Mrs. Rawson and others of the staff of the National Utility Poultry Society. The Great Eastern Railway Company provided cheap tickets and special facilities for the British party, which numbered nearly 150. At Scheveningen special accommodation had been reserved by the Dutch Committee for the Congress visitors, and the papers were read and the discussions held in the Kurhaus Hotel. The display of birds and other exhibits was held in the Zoological Gardens situated nearly midway between The Hague and Scheveningen. The Exhibition was officially opened in the presence of H.M. Queen Wilhelmina by H.R.H. the Prince Consort. The royal party then proceeded to the Kurhaus Hotel where the Congress was officially opened by the Minister of Agriculture. Addresses were given by Dr. Lovink, Director of Food Supplies for the Netherlands and also first President of the Congress, the Portuguese Minister, and Mr. Edward Brown, second President of the Congress. Some 20 countries were represented by about 50 delegates.

Meetings were held each day from Tuesday until Friday from 9 a.m. to 5 p.m. Owing to the fact that some 80 papers on various aspects of the poultry industry were presented, the Congress was divided into four sections, which met simultaneously. On Saturday the final meeting of the Congress was held, when the resolutions passed by the various sections were discussed and adopted. Among these resolutions were recommendations—(1) As to the importance of placing at the disposal of scientists means for the study of Mendelian laws and their application especially in regard to poultry. (2) The desirability of continuing egg laying trials for 56 weeks so that more valuable conclusions may be drawn regarding the inheritance of laying qualities. (3) That it is advisable that all eggs exported from any country should be marked with the name of the country of origin, and that uniform rules of control should be adopted for the international and national egg trade, and that such regulations should be fixed by international convention and made applicable to all countries. (4) That consideration should be given to the advisability of taking official

measures regarding infectious diseases of poultry, and that research should be undertaken in poultry diseases, their prevention and treatment, especially those involving the use of vaccine and serums, and also that in every country where poultry keeping is of economic importance instruction on poultry diseases should be properly organised. (5) That the question of the international and national standards of poultry breeds be definitely settled by the next Congress.

With regard to the Exhibition, exhibits of birds and appliances were received from 14 countries. Altogether there were 563 pens of poultry and pigeons numbering 1,606 birds. There were on view 75 pens of birds from Great Britain and Ireland, and these received general admiration and a number of sales were effected. The total sales of birds at the Exhibition was of an estimated value of some £1,300. It is estimated that 30,000 people visited the Exhibition.

The Congress was the means of collecting the latest information on the various aspects of the poultry industry, and provided a channel for the dissemination of this knowledge among various countries. It will no doubt also stimulate the export of stock poultry from various countries.

A book entitled "Transactions of the First World's Poultry Congress," which contains all the papers read at the Congress, may be obtained from M. C. S. Th. Van Gink, Office of Secretary-General, 30 Bezuidenhoutschewez, The Hague, Holland.

An illustrated "Handbook and Souvenir" of the British Section of the World's Poultry Congress may be obtained on application to the offices of "The Feathered World," 9, Arundel Street, Strand, London, W.C., or to The National Utility Poultry Society, 8, Vincent Square, Westminster, S.W.1, Price 1s.

HORTICULTURE IN THE PENZANCE AREA OF CORNWALL.

G. P. BERRY,
Ministry of Agriculture.

THE Penzance district may be generally described as devoted to early potato and broccoli culture. Although a certain amount of general vegetable and fruit growing is carried on it is not sufficient even to supply the local needs in the summer months during the visitors' season, and the bulk of the early vegetables other than potatoes and broccoli, comes from other districts.

Early Potatoes and Broccoli.—These are mainly confined to the neighbourhood of Penzance, embracing the townships of Marazion, Gulval, Newlyn, Paul, Mousehole, Ludgvan and Hea Moor. The holdings are small and consist of a series of fields or small enclosures surrounded by stone walls or hedges; for the most part they are situated on the slopes facing south, and the cropping is carried on from sea-level up to about 300 feet. Wind is the disturbing factor in the climate, and without shelter it is impossible to get good results with any crop which the small holder may grow. Occasionally frost is sufficiently severe to check the early potatoes, and in the last week of April, 1921, some damage was done in the low-lying places. The annual rainfall is about 40 inches, and in 1920 it was 46.84 inches. Extremes of drought are experienced in some seasons, and the early potato crop has been known to be planted and lifted without the benefit of a good soaking rain.

Considerable difficulty is experienced in obtaining a suitable hedge plant which will both grow quickly and resist the spray. At one time Elder (*Sambucus nigra*) was largely used, but recently this shrub has been replaced to a considerable extent by *Euonymus* sp. There are indications also that the New Zealand shrub *Pittosporum crassifolium* will grow well and withstand the sea breezes. It is during the winter and early spring that shelter is so essential, for the high temperature then prevailing enables crops to make growth when in the south generally they are dormant.

Soils.—There is considerable variation in the Cornish soils, but potato and broccoli culture is carried out on sandy loams, varying from highly sandy soils in some places to soils of more body in others, the stronger soils resembling the Lincolnshire silts. The depth varies from about 9 inches on the shallower to

18 inches and over on the deeper soils. The physical condition of the soils is ideal as regards drainage and friability, there are few stones, and the temperature rises rapidly under the influence of the sun in spring. The subsoil is for the most part sand and gravel, although soils overlying the basalt rock have been brought into cultivation. Lime is deficient over a large area, and a general shortage of phosphates is indicated.

System of Cropping.—Over a large area the sole rotation is early *potatoes* and *broccoli* The early potato crop is lifted during the first three weeks of May, and the broccoli plants are put out as soon after as the land and climatic conditions admit. Early and late protecting varieties of broccoli are grown and most of the seed is saved locally. This practice leads to the production of a great variety of types, many of which are coarse, loose, of bad colour, and apparently not to be compared with some of the strains of broccoli in other parts of the country having a more vigorous climate. The county authorities are endeavouring to help the growers in the matter of suitable strains, and crosses are being made at Gulval. A considerable amount of early cabbage is grown and despatched in nets to the Midland markets.

The varieties of early potatoes at present grown are May Queen, Duke of York, Sharpe's Express and Advance. At one time May Queen was the most popular variety, but it has been superseded by Sharpe's Express. Next in importance are Duke of York and Advance, the latter being Dargill Early under another name. Express and Advance are not as early as May Queen or Duke of York, but the Cornish grower finds that it is better to be a week later in lifting provided a much larger crop is obtained. On the very early soils both May Queen and Duke of York are said to be losing their vitality. Seed used to be obtained direct from Scotland, but in recent years once-grown from Lincolnshire is used. The tubers are planted at the rate of from 2 to 2½ tons per acre, in rows 9 in. to 12 in. apart and 4 to 6 in. between the sets. The seed is cut severely to reduce the cost of seeding, and the crop is grown entirely on the flat through the season of growth. The ground is thoroughly worked with the spade or cultivator according to the size of the field, and the potatoes are ploughed in with a single-furrow plough or planted with the Cornish spade. Lifting is always done with the spade, and the crop is placed in bushel hampers, sieves or half-barrels and despatched to the south, midland, and northern markets. The crop usually

averages from three to four tons per acre, but in a dry season it is considerably less.

Bulbs form an important crop on most of the small holdings: in some cases these are well cultivated and kept clean, but in others the bulb areas are allowed to become over-grown with weeds and rank grass. Sometimes the bulbs are grazed by horses or the areas mown and made into hay; these practices, however, cannot tend to the general welfare of the bulbs. The best growers apply top dressings of mellowed seaweed and other decayed vegetable matter as well as chemicals, and periodically lift and replant their bulb areas. Growers who force early potatoes and bulbs under glass take a crop of tomatoes in the houses during the summer. The forcing of Arum Lilies (*Calla Ethiopica*) is also very profitable, as the flowers have made high prices for the last four years; they bloom naturally in the open in April, but under glass they flower at Christmas and onward.

Fruit Trees.—In the valleys a considerable amount of orchard fruit, mainly apples, is grown. The trees receive practically no attention in the way of pruning, spraying or manuring, and they are old, stunted and lichen-covered. The varieties of apples are out of date on the majority of the holdings, Keswick Codlin and local seedlings predominating. It must not be assumed, however, that the district is unsuitable for fruit growing. Several young plantations which were examined, proved that modern varieties of apple and pear, bush trees on paradise and quince stocks, will grow and fruit satisfactorily when given proper attention. All classes of small fruit can also be successfully grown, particularly raspberries and gooseberries. Wind is again the factor which has to be guarded against, and unless shelter can be obtained, it is little use attempting top fruit.

Manuring the Potato Crop.—The supply of plant food to the soil forms a very important part of the cultivation, especially where a crop has to make rapid growth in a short growing season. The greatest attention is paid to this operation, but in the absence of experimental data there is room for doubt as to whether the system of manuring generally adopted is on sound lines. The usual custom is to accumulate a stock of natural manure which consists of seaweed, leaves, town manure, fish offal and any other decaying matter. If live stock of any description is kept, the manure made by them is incorporated. The whole mass is made into a compost heap (midden) at some convenient spot on the holding. In the construction of the

dung heap layers of sea sand are introduced at intervals, and the top of the heap is also covered with sand and soil. The sea sand in the Penzance area contains a high percentage of lime derived from shells and other calcareous matter, and as much as 5 per cent. is quite common. This sand aids in the decomposition of the seaweed and fish offal, and will ultimately benefit the land which is naturally deficient in lime; how far it tends to liberate feeding material from the manure into the air does not seem to have been definitely ascertained. This heterogeneous mass is applied to the soil in winter or early spring at the rate of 80-120 loads and upwards per acre. Assuming that a load is only 13 cwt. owing to the inaccessibility of many of the small fields, the quantity represents a very heavy dressing. In addition to this, chemicals are applied in apparently excessive quantities. Nitrate of soda and sulphate of ammonia are applied as top dressings, usually in equal proportions, from 10-14 cwt. per acre being used. In some cases sulphate of ammonia alone is applied at the rate of 8-10 cwt. per acre. Superphosphate is also applied, seldom less than 10 cwt. per acre. It is generally assumed that sufficient potash is applied in the dressing of seaweed and dung, but there are no experimental data to prove this. Some of the growers consider that an adequate return is not obtained for this heavy outlay on chemicals, and several have been experimenting by leaving a portion undressed. In the Isles of Scilly very little nitrogenous fertiliser is used, although the soils are very similar to those of the mainland. Seaweed, fish offal, &c., are principally used, but when a heavy dressing of "green" seaweed is applied very poor results are obtained. The crop is considerably retarded and stunted by the undecomposed seaweed and does not wholly recover during the season. This points to the necessity of having the material decomposed and mellowed by the atmosphere before application to the soil. No spraying is done, even in a bad year. The usual course is to lift the crop as speedily as possible when disease appears on the foliage and before the spores have had time to fall and enter the tubers.

Potato Diseases.—Considerable patches were affected with black leg (*Bacillus atrosepticus*), which was most apparent in May Queen and Duke of York. Sharpe's Express appeared to be very little affected.

Mosaic disease was very prevalent, principally in May Queen and Duke of York. Growers are of the opinion that these two varieties are becoming "played out" in the Penzance area,

and that loss of constitution goes hand in hand with Mosaic disease.

The whole industry in the Penzance district requires the help of the scientist. Experiments should be carried out both with varieties and manures, especially the latter, and be clearly demonstrated by experimental plots on the grower's premises. The economic rate of application of nitrate of soda and sulphate of ammonia should be ascertained, as also whether a combination of the two is better than a standard dressing of each, alone.

The question of transport is causing anxiety to the growers, as that provided is of the most primitive kind. At the siding where the broccoli and cabbage for the North are loaded there is no covering. The trucks are of the type used to carry coal and manure, and the journey to the markets often occupies 48 hours. At times whole trainloads of broccoli in crates and cabbages in coir nets can be seen along the line drying in the sun and wind. The condition of the vegetables on finally reaching the consumer, may be easily imagined after passing through the market and the retailer.

RESEARCH IN BREWING.

BREWING and farming are interdependent. The brewer obtains his raw material from the farmer, and the farmer relies on the brewer for one of his principal markets; the condition of the one industry cannot therefore fail to be a matter of concern to the other. Any progress, too, achieved in either industry as a result of research must be of benefit to the other. Research into questions relating to hops and malting barley is ground common to the two industries, and growers of these products cannot afford to be ignorant of the research work recently initiated by the brewing industry. Moreover, an account of the organisation and finances of this work is not without value to those engaged in the development of research work on purely agricultural subjects.

Initiation of the Scheme.—The history of the brewing research scheme is a short one. In 1918 funds were allocated to the Department for Scientific and Industrial Research, and thereafter research associations began to be formed by most of the leading manufacturing industries. It was quickly realised that the fermentation industries could not do otherwise than fall into line with the general movement. The Institute of Brewing, after consultation with representative brewing firms and with the Brewers' Society, was encouraged to proceed with a scheme for research work, it being decided from the outset to work on independent lines without any assistance by way of Government grants.

Finance.—To obtain funds for the work a new class of members (Research Fund Members) of the Institute was established. This new form of membership is open to corporate bodies and firms or partnerships (as such) and individuals carrying on business as brewers of beer or vinegar, maltsters, distillers, manufacturers of cider and wine, and barley and hop growers. These members were invited to pay such subscriptions as might appear to them to be appropriate to their capital interests (with a minimum annual subscription of ten guineas), the subscription being credited to a special research fund account and used for scientific investigation and research for the benefit of the fermentation industries generally.

By the end of 1919 the Research Fund membership was 136 with an annual subscription list of £4,357; by 31st December, 1920, these had been brought to a total of 197 members with an annual subscription list of £5,046.

The following accounts show the financial position of the Research Fund on 31st December, 1920:—

EXPENDITURE AND INCOME ACCOUNT.
1ST JANUARY TO 31ST DECEMBER, 1920.

Dr. Expenditure.	£	s.	d.	Income. *Cr.*	£	s.	d.
To Preliminary Expenses ...	351	1	3	By Members' Subscriptions	5342	17	0
„ Hop Investigations at Wye	125	0	0	„ Donations to the Fund	61	15	0
„ Hop Investigations at Manchester	196	5	0	„ Deposit Interest...	216	8	4
„ Timber Investigations, London	187	10	0				
„ Stationery and Printing ...	64	14	11				
„ Postage	37	13	9				
„ Sundry Expenses		19	6				
„ Institute Establishment Charges (Proportioned)...	413	14	0				
„ Balance carried forward...	4244	1	11				
	£5621	0	4		£5621	0	4

BALANCE SHEET.—31ST DECEMBER, 1920.

Dr. Liabilities.	£	s.	d.	Assets. *Cr.*	£	s.	d.
To Subscriptions received in advance	102	10	0	By Subscriptions in arrear for 1920...	128	15	0
„ Sundry Creditors	30	15	2	„ Cash at Bank on Current Account	248	12	1
„ Balance in favour of Fund	4244	1	11	„ Cash at Bank on Deposit Account	4000	0	0
	£4377	7	1		£4377	7	1

Organisation.—A Research Fund Committee was set up consisting half of Research Fund members and half of representatives of universities, colleges, experimental stations, companies, firms and individuals willing to provide facilities for scientific investigation and research. It is a principle of the scheme that the investigations shall be carried out for the benefit of the fermentation industries as a whole and not for a single firm or group of firms. The Committee will not assist in the commercial exploitation of patented inventions, but in specific cases where funds are needed for working out on a large scale a process or device already patented, the Committee will consider the question of making a grant for this purpose.

The Research Fund Committee has made provision for the appointment of Advisory Sub-Committees for specific branches of research, *e.g.*, hops, timber and barley. These Advisory Sub-Committees initiate researches into their respective subjects, and consider applications from *individual* workers for grants from the fund. Provision has also been made in the scheme for a survey of existing researches by means of which it is hoped that any serious overlapping will be avoided.

The Committee further aims at preventing successful research workers from being unfairly exploited, and where the means for research has been found from the Research Fund, the Committee will ensure, so far as in them lies, that the discoverer or inventor shall not go unrewarded. Lastly, the scheme makes provision for the appointment by the Research Fund Committee of Advisory Officers to act in liaison between the various sub-committees and the investigators.

Research Work.—Work has so far proceeded in three main directions, viz., hops, timber and barley.

The timber research does not, perhaps, at the moment concern the agricultural industry very closely. On the other hand the barley research opens out such a vast field of enquiry that, before a specific programme of work can be embarked upon, the particular line of research showing most promise of direct value to the Brewing Industry has to be ascertained. To this end a summary of the published literature dealing with the evaluation of barley from the nitrogen standpoint has been prepared, and is now under consideration.

Hop Investigations.—The work on hops has already made progress, and may be given in some detail as indicating the lines on which research in general may be expected to proceed. Work on hops is divided into five main sections:—(1) the breeding of new varieties; (2) manuring; (3) drying; (4) testing for brewing value; and (5) chemical investigations.

For the work on the breeding of new varieties the Brewing Research Fund Committee has made use of the research organisation already set up by the Ministry of Agriculture. This research is carried on at the South-Eastern Agricultural College, Wye, and at the East Malling Research Station. The aim is to breed new varieties which will produce a heavy yield of hops resistant to disease, and at the same time contain the highest amount possible of resins and other desirable brewing qualities. The newly raised seedlings are planted out in the College Experimental Hop Garden which now contains over 4,000 seedlings, and those varieties showing most promise as heavy croppers of good quality are transferred to the hop garden at the East Malling Research Station where tests are carried out on a larger scale.*

* The Committee has decided for the time being to contribute to the College the sum of £500 per annum to cover the cost of (1) the part maintenance of the Hop Nursery and raising seedlings, (2) the chemical analyses of the hops grown at East Malling Research Station, and (3) the salary of a part time investigator.

As regards manuring, two Kentish growers have each placed one acre of land at the disposal of the Committee for the purpose for the next ten years. The main object is to find out whether the manurial elements in common use, viz. nitrogen, phosphorus and potassium, have any effect on the composition, *i.e.* brewing value, of the hop strobiles. The experiments will show whether the composition of the hop is influenced by purely inorganic manures. Plots will also be obtained elsewhere.

Four experimental kilns have been erected at Beltring, near Paddock Wood, for research work on the principles of hop drying, the object being to determine the ideal conditions of drying, the subsequent step being the designing of a kiln on practical lines which will most nearly reproduce those conditions. The following problems are being studied:— (1) the effect of varying temperatures with constant air current; (2) varying air current with constant temperature; (3) the influence of moisture content of the hops; (4) the effect of burning varying amounts of sulphur; (5) the effect of products of combustion of open fires; (6) the use of dried air; (7) variation of height of air above fire; and (8) the influence of the weather.

Comparative brewing trials of certain varieties of the hop are being made under the auspices of the Committee by a well-known London firm of brewers in order to test the respective brewing values of these varieties.

The chemical investigations are designed to determine those constituents of the hop which are most useful to the brewing industry, the methods of evaluation so far employed being purely empirical. The problem now being investigated is the isolation and identification of the constituent, or constituents, on which the preservative or antiseptic properties of the hop depend. This investigation is under the direction of Dr. F. L. Pyman at the Municipal School of Technology, Manchester, which possesses special facilities for this work. The results of past researches point to the probability of the constituents containing the antiseptic or preservative qualities being found in the soft resins of the hop. In order to obtain material for investigation, the investigators have extracted the soft resins from a large quantity of sulphured and unsulphured hops and the extracts are now being examined. It is estimated that these chemical investigations will cost about £600 per annum.

DEMONSTRATION OF FLAX-PULLING MACHINES.*

PUBLIC trials of flax-pulling machines were arranged by the Irish Department of Agriculture and Technical Instruction to take place at Ballyveasey, Carnmoney, Belfast, on 26th July, 1921. Only two machines took part in these trials:—

(*a*) The Crawford-Bennett Machine made by the York Street Flax Spinning Co., Belfast.

(*b*) The Fibre Corporation Machine made by Messrs. Marshall, Sons & Co., Ltd., of Gainsborough.

The Crawford-Bennett Machine is self-propelled, and consists essentially of a polygonal drum of about 5 ft. in diameter hung at the back of a motor chassis so that its lowest portion is about 6 or 8 inches above the ground. At intervals of about 45 degrees, rows of teeth extend across the width of the drum and project about 5 inches beyond its circumference. When the car is driven on its reverse gear the drum is rotated by suitable gearing in the opposite direction to the ground wheels and caused to advance towards the flax to be pulled at a slow speed. The pulling is effected by the projecting combs referred to, which pass up the flax stems until they encounter the seed heads, when the upward movement of the combs causes the plant roots to give way. The flax is carried over the circumference of the drum and delivered at the top, where it is forced from the teeth by a longitudinal metal lath, operated by a cam, which presses upwards from the base of the teeth. When at the top of the drum and freed from the uplifting teeth, the pulled flax is engaged by a further set of combs mounted on endless chains, which bring the flax forward and deliver it on to a travelling canvas, which carries it in a sideways direction for delivery on to the ground clear of the path of the machine, either in loose bundles, or in bundles automatically tied.

The Fibre Corporation Machine is built to attach to a motor tractor and consists of endless chains passing over fore and aft cogs carrying a number of combs at equal intervals. This mechanism is mounted on a suitable carriage which is attached to a tractor and made to travel in the same direction as the ground wheels. A similar action is employed for pulling as in the Crawford-Bennett Machine, combs being caused to engage the heads of the standing flax, but, in this case, the combs are caused to enter the crop from above in advance of the travelling machine. The engaged flax is drawn underneath the pulling mechanism at the slow rate of the difference

FIG. 1.—The Crawford-Bennett Flax Pulling Machine

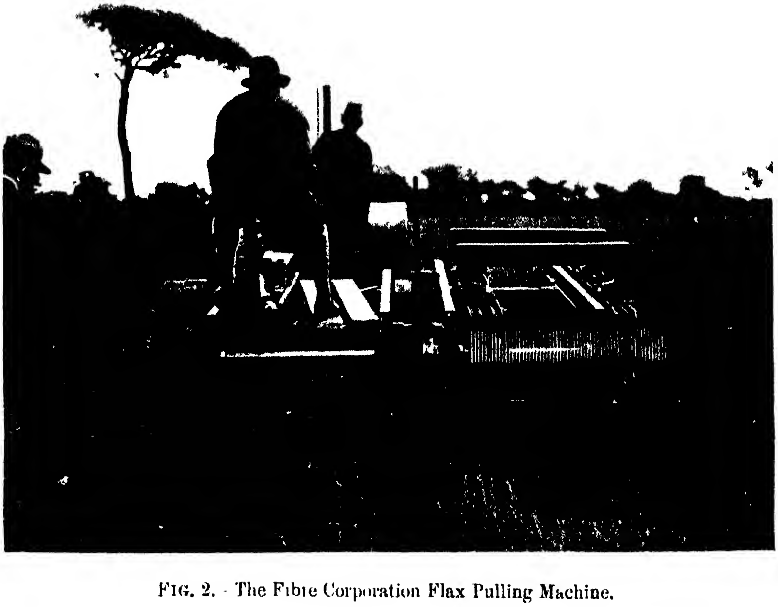

FIG. 2.—The Fibre Corporation Flax Pulling Machine.

between the speed of the advancing ground wheels and the backward speed of the revolving combs. This feature is a very important one as it enables the ground speed of the machine to be greater than the pulling speed of the combs. The pulled flax is delivered on the ground at the rear of the machine, being freed from the engaging pulling combs on the underside of the machine. In this case the pulled flax is left in the track of the machine, in swathes which have to be tied up and removed before the machine returns.

No injury to the flax stems could be detected after pulling by these machines, but it was noticed in each case, although more particularly with the Fibre Corporation Machine, that the flax heads were very much tangled, a fact which must render "rippling" difficult if not impossible. In both cases the heads were brought evenly together so that, depending upon the evenness in length of the straw pulled, the root ends were left at various distances in the bundle, and owing to the tangled condition of the heads it was difficult to even-up the root ends when making up into bundles.

While the trials were in progress the Crawford-Bennett Machine, by virtue of the elevation to which the pulled flax is brought, allowed the pulled straws to be tossed about in the breeze a good deal, causing a confusion of the straws in the bundle of pulled flax ultimately discharged. On the other hand, although not affected by wind disturbance, the Fibre Corporation Machine was found to be depositing the swathes of pulled straws upon flax which had not been pulled by the combs, making it difficult to lift and tie up the pulled swathes.

Generally, with the exception of the unpulled flax beneath the swathes of pulled flax already referred to in the case of the performance of the Fibre Corporation Machine, the quantity of flax left unpulled by these machines under the ideal condition of the trial was scarcely significant, being for the most part, short stems which usually fail to survive the operations culminating in scutched fibre. It is doubtful whether either machine would be able to deal with any crop if "laid" at all.

In the performance of these two machines there appears to be a very big advance towards solving the flax pulling problem, and with the prospect of further improvements before next season, one may reasonably hope that the machine pulling of flax crops will be commercially possible at no distant date.

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NOTES ON MANURES FOR NOVEMBER.

E. J. RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Ashpit Refuse from Towns.—In view of the shortage of stable manure in cities, as a result of the increase in motor traction, it has become necessary to inquire whether, and to what extent, ashpit refuse from towns can serve as a fertiliser. In some cases a useful manure is obtainable and some of the heavy land farms near London have used it with good results. In spite of its smell, however, it is not rich in fertilising constituents, and in its raw state it is too coarse to be of much value except on heavy land where it has a lightening effect. Attempts are now being made by some Councils to grind the material and otherwise improve it, and a truck load as sent out from London by the contractors, Messrs. Cloke of West Hampstead, is being tested at Rothamsted. Analyses of some of the samples from Bermondsey and Southwark are as follows:—

	Per cent.
Organic matter	31·20
Lime	2·86
Phosphoric Acid (P_2O_5)	0·53
Potash (K_2O)	0·47

There is an element of risk in using refuse material of this nature on land where potatoes are to be grown, inasmuch as it may contain diseased potato peelings which may infect the land for a subsequent crop. On the other hand, mangolds, cabbages and other farm crops are not likely to suffer. This material is worth trial on heavy soil so long as the cost does not become too great.

Time to apply Basic Slag on Clover Leys.—There are two possibilities in the way of using basic slag on clover leys: it may be applied to the corn crop in which the clover is sown, or to the young plants after the corn has been cut and carted. The choice between these two ways turns on the vigour with which the clover grows. In some parts of the west country clover starts so well in the corn that if it is treated with slag it develops to an inconvenient extent; in such cases the addition of slag should be delayed till after the corn has been cut; it could, for instance, go on now. In the eastern counties such vigorous growth in the corn would be exceptional, and the slag

can therefore go on before the clover is sown so as to allow ample time for the full effect to be produced.

The Cockle Park experiments show that the clover ley constitutes the most convenient and profitable place in the rotation for the introduction of basic slag.

Professor Gilchrist's Method of using Waste Lime.—The writer recently had an opportunity of seeing Professor Gilchrist's method of using waste lime on arable land in the north of England. The material, known as "Chance Mud," or "Lime Mud," containing about 60-70 per cent. calcium carbonate and free from injurious constituents, is cheap, and while not in dry powder condition is in such state that it can be spread on the land from farm carts. It is put on the "Hay Stubble" at the rate of 4½ tons per acre, then ploughed in. Oats are then sown and after this crop is removed the land is ploughed for roots. This ploughing of course brings the waste lime up to the surface again when it dries and falls to a fine powder. The method is sound because the oats stand in no need of lime and therefore suffer no inconvenience from having the material buried; the roots on the other hand require it, and therefore benefit from having it brought up to the surface.

Injury to Root Crops from use of Superphosphate.—Instances have come to the writer's notice from the north of England of damage done to root crops by superphosphate this season, presumably through encouraging finger-and-toe. It is desirable to have the exact cause of the trouble determined if possible, and farmers who have suffered are requested to communicate with the Rothamsted Experimental Station stating whether finger-and-toe was common or not.

Use of Gas Liquor as Substitute for Sulphate of Ammonia.—A correspondent writes to say that he is offered gas liquor at a cheap rate and asks if and how he can use it as fertiliser. The direct use of this material is not to be recommended: the proper course is for the gasworks to convert it into sulphate of ammonia. If this is entirely ruled out, however, then the gas liquor can be used provided:—

1. Sulphides, sulphocyanides and cyanides are absent, or occur in traces only.
2. Frequent determinations of the ammonia content are made.

The liquor in question was of the so-called 12 oz. strength, *i.e.*, 12 oz. of pure sulphuric acid were needed to neutralise 1 gallon. This is about 10 times as strong as ordinary liquid manure

and must therefore be diluted to this extent and then further diluted just as if it were liquid manure. It can be put on grass land and on land intended for roots, but this should be done in winter or in early spring to avoid any risk of possible harmful effects on the young plants.

Should Farmyard Manure be ploughed in at once or can it be left on the Surface?—Several inquiries have been made as to whether farmyard manure should be ploughed in directly it is applied to the land or whether it can be safely left exposed on the surface after it has been spread. It is common in some districts, *e.g.*, east Suffolk, to spread farmyard manure on bare fallows in June and plough it in at some later date; also to spread the manure on clover stubble early in September and leave it till the ground is soft enough for ploughing, which might be several weeks. Unfortunately no exact information is available, but from what is known it seems probable that the best course is to plough in the manure directly it is spread, and if necessary to delay spreading until ploughing is possible. Naturally this recommendation must be tempered by the necessity for distributing labour as evenly as possible over the season, and it may in the end prove more economical to save labour even at the expense of some wastage in manure.

Spread Farmyard Manure Evenly.—The necessity for spreading artificial manures evenly is well recognised, but farmers are not always able to secure as even a distribution of farmyard manure as is desirable. In the Lothians may be seen an implement, the "Dumb Tam" (so named, it is said, after its inventor), which marks off the ground into squares of 18 ft. each side, of which 134 constitute an acre all but 16 sq. yd. A heap of 2-2½ cwt. of farmyard manure is then deposited on each square and can be spread evenly.

Influence of Chalk or Limestone on Young Seeds.—The following communication from a good arable farmer in Bedfordshire affords interesting evidence as to the valuable effect of chalk on the seeds mixture, the land being brown stony clay overlying the chalk: "I dig deep drains 4 to 11 ft. deep to get the spring water out and spread the chalk as widely as possible each side of the drains and the effect is as you say and have said. The ground is more tilthy, more dry and more damp*; for instance, I have sown a variety of seeds over these chalked places and the seeds are nearly all alive and look comparatively well, but where there is no chalk seeds have practically disappeared, so that if I could have chalked all the

* *i.e.*, more dry in wet weather and more damp in dry periods.

pieces thus sown with seeds, it must have gone a long way towards paying in this great drought in one crop. But in one place last year the chalk had a wonderful effect on winter oats, there being a tremendous crop as far as the chalk went, but a great falling off on the rest. This piece was winter oats again this year and there was again twice as big a crop, but much less than last year."

It is noticed, however, that all chalk is not equally effective: it will probably be found that the softer chalk is the more useful as it will more quickly come into action than the harder deposits.

Nitrogen Starvation on Water-logged Soil.—A very interesting point is raised by a farmer who writes: "I noticed if one has a piece of water-logged land the crops have the appearance of starvation of nitrogen, but if a drain is dug across this piece of land to any depth, say 10 ft., and no care is taken how the soil is returned the crops that follow are in most cases many times larger just over where the drain is dug, but no wider, while it seems that the rain must have a better chance of washing nitrogen out of the soil over the drain than elsewhere; yet 2 cwt. sulphate of ammonia per acre would not make the crops at the side equal to those immediately over the drain." The explanation is that nitrogen starvation has occurred on the undrained soil, but it is caused not by washing out of nitrates from the soil but by the decomposition of nitrates which sets in as soon as air is excluded. A number of soil organisms have the power of decomposing nitrates in absence of air, and they do it with so much rapidity that the plant suffers. The remedy is to let in air, when the loss is completely and automatically stopped; this can best be done by arranging for drainage.

Non-fertilising Constituents of Manures.—A farmer writes to ask what amounts of substances are present in the ordinary artificial manures besides the nitrogen, phosphate and potash shown in the analysis. The constituents in three common cases are as follows:—

Nitrate of soda:—Plant food in 1 cwt.: Nitrogen, 17 lb., the same amount as is present in 106 lb. of albuminoid or protein; Soda, sufficient to form in the soil 188 lb. of ordinary carbonate of soda or 1 cwt. of bicarbonate of soda. This soda has some effect as manure, but is apt to injure the texture of a heavy soil.

Sulphate of ammonia:—Plant food in 1 cwt.: Nitrogen, 22 lb., equal to the amount present in 137 lb. of albuminoid or protein; Sulphuric acid, sufficient to consume 85 lb. of calcium carbonate or about 100 lb. of ordinary good grade limestone.

Superphosphate:—Plant food in 1 cwt. of 26 per cent. grade: 29 lb. pure tricalcic phosphate; about 56 lb. dry gypsum (or 62 lb. ordinary gypsum) which has some fertiliser effect.

The Cultivation of Sage and Thyme.

SAGE (*Salvia officinalis*) has long been under cultivation in market, private and cottage gardens. The plant is a native of southern Europe. The leaves have been used for flavourings and stuffings for centuries, and at one time an infusion was made from the leaves, known as sage tea, which was said to have certain medicinal properties. There is always a certain demand for the crop on large markets, but this demand fluctuates greatly and can be easily overdone. It is therefore not by any means a safe crop to cultivate on a large scale and the same may be said of Thyme. At one time very considerable quantities of sage were grown in the Mitcham district of Surrey, and the Evesham market gardeners made a special line of the crop, but the time came when the supply very much exceeded the demand and growers consequently gave up its culture. Leading market gardeners in Middlesex still grow small quantities according to the demand.

The plant succeeds best on light, warm and dry soils and can be raised from seed sown in frames or on a warm spot in spring. The plants when well established and hardened off can be lifted carefully with good balls of soil and placed in permanent position 1 foot apart and 18-24 inches between the rows.

By far the most common method of propagation, however, is by slips and cuttings or by pieces of the young growth well ripened and broken off with a slight "heel." These slips are inserted in a shady border or cold frame in April, May or June, and occasionally watered until rooted, when they can be planted in the open and at the distances already mentioned. There has been a general tendency in recent years to plant wider, so as to admit more easily of horse labour. Three feet between the rows and 2 feet between the plants has been a common distance. The ground is kept in good tilth and clear of weeds, and the extremities of the leading shoots are pinched to produce bushy plants by the encouragement of lateral growth.

For winter use it is bunched and dried. The side and main growing shoots are cut and dried in a dark, cool, airy shed, and then tied into bunches, or they may be tied in bunches immediately after cutting and suspended from the roof of a cool shed to dry.

Thyme.—There are two varieties of this herb, the large green-leaved (*Thymus vulgaris*) and the shorter variety known as Lemon Thyme (*Thymus citriodorus*). The former is most exten-

sively used as a flavouring for soups and stuffing. It thrives best on a light warm soil.

The plants are usually raised from seed sown in April in shallow drills 8-12 in. apart. They should be thinned out in June and July to 4 inches apart and the thinnings used for planting up fresh ground at the same distances apart in the rows and between the plants as already indicated. This herb may be also bunched and dried for winter use. Cuttings can also be taken, but seedlings are the usual method of propagation.

Where only a small quantity is required a single drill may be sown at the margin of a border and left unthinned, when it will form a good edging.

At the present time there is a rather good demand for English herbs, and English sage has been commanding a price of about 150s. per cwt. as compared with 30s. per cwt. for Dalmation, French and Greek produce. English Thyme has been commanding about 178s. per cwt. as against 50s. per cwt. for the imported article. It is generally recognised that the English article is very much superior to the imported. The annual home consumption has been computed at about 200 tons of sage and 50 tons of thyme. It will therefore be apparent that although at present the demand is good, the area necessary to produce it does not amount to a very large acreage, even taking the low estimate of 1 ton per acre.

Grants for Agricultural Research.

THE Ministry, with the approval of the Development Commissioners and the Treasury, has awarded the following special research grants for work in connection with agricultural problems during the academic year October 1921 to September 1922. These grants are in addition to the annual grants-in-aid made to Universities and Research Institutes for the maintenance of agricultural research departments.

	Institution.	*Investigation.*	*Amount.*
1.	University College, Aberystwyth.	Life History of Moniezia (tape worm).	£300
2.	Armstrong College, Newcastle.	Composition of Oat Straw -	250
3.	School of Agriculture, Cambridge.	Silver Leaf Disease - -	400
4.	School of Agriculture, Cambridge.	Soil Moisture - - -	100

	Institution.	*Investigation.*	*Amount.*
5.	Zoological Department, Cambridge University.	Soil Bionomics	£300
6.	East Anglian Institute, Chelmsford.	Insect Fauna of Soil	200
7.	Imperial College of Science, London.	Change of Seed (Potatoes)	75
8.	Imperial College of Science, London.	Wart Disease of Potatoes	230
9.	Imperial College of Science, London.	Disease of Hops	35
10.	Royal Horticultural Society.	Green Manuring	200
11.	South Eastern Agricultural College, Wye.	Insect Pests of Turnips	120
12.	South Eastern Agricultural College, Wye.	White Clover Investigations.	205
13.	South Eastern Agricultural College, Wye.	Crown Gall Disease of Fruit Trees.	205

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Acarine Disease of Bees.

IT will be interesting to bee-keepers to learn that, at the apiary of a recognised expert in Norfolk, the fact appears to have been definitely established that Italian queen bees provide distinct powers of high resistance against Acarine disease in those hives in which they are introduced. As is well known, the Ministry has during the last few years supported a scheme to supply bee-keepers with healthy queen bees from the best apiaries in the North of Italy. It is satisfactory to find that as far back as 1912 the Norfolk expert referred to introduced Italian queen bees into his apiary, which was at that time seriously attacked by Acarine disease (also known as Isle of Wight Disease) and that the "crawling" stage, usually a sign that the disease is becoming far advanced, was gradually overcome. Since that time, his apiary has been built up until there are 26 stocks in which there is not a sign of Acarine disease. This expert has recommended others in the county to adopt the course which he himself successfully pursued. It is stated that they have done so with wholly satisfactory results.

Rabies.—No case of Rabies has occurred in any part of Great Britain since the 7th June last. The whole of the restrictions imposed by the Berkshire and District (Muzzling and Control of Dogs) Orders of 1920 and 1921 were withdrawn as from 1st October, no case of Rabies having occurred in that area since the 1st February. This area included portions of Berkshire, Buckinghamshire, Oxfordshire and the northern part of Hampshire. There is now only one area remaining subject to restrictions on account of Rabies, viz., an area comprising small parts of Hampshire and Wiltshire surrounding Salisbury, Winchester and Southampton. All dogs in this area must still be muzzled, and no dog can be moved out of the area without a licence from the Ministry.

West Surrey Goat Club.—The attention of the Ministry has been called by Mr. T. W. Palmer, hon. secretary to the British Goat Society, to the note on the West Surrey Goat Club which was published in the September issue of the *Journal* (p. 565), in which it was stated that one of the goats "had given on the day of the show over 8lb. of milk." This appears to be an understatement, as Mr. Palmer points out that the goat referred to "gave 8lb. of milk at one milking, and during the 24 hours gave 12lb. 12oz. Other records during the 24 hours were as follows:—10lb. 14oz., 10lb. 4oz., and 10lb. respectively, while there were seven goats which yielded more than 9lb. but less than 10lb. each."

Leaflets issued by the Ministry.—Since the date of the list given on page 670 of the October issue of the *Journal*, two new leaflets have been issued:—

No. 372.—Pig Feeding.
" 378.—Beeswax.

The following leaflets have been re-written:—

No. 73.—The Cultivation of Maize for Fodder.
" 89.—Fluke, or Liver Rot in Sheep.

The following leaflets have been revised:—

No. 58.—The Nematode or Round Worm Disease of Poultry.
" 78.—Tuberculosis of Poultry.
" 87.—The Die-back Disease of Fruit Trees.
" 93.—Farmyard Manure.
" 120.—Peach Leaf-Curl.
" 148.—Planning and Planting a Fruit Plantation.
" 153.—Storing of Mangolds and Turnips.
" 173.—Potato Growing.
" 204.—Apple Mildew.
" 207.—Strawberry Cultivation.
" 228.—Prevention of Cruelty to Animals.
" 240.—Farm Book-keeping.
" 275.—Improvement of Poor Hill Pasture.
" 286.—Narcissus Flies.
" 322.—Winter Pruning Bush and Half Standard Apple Trees.

The following leaflets have been withdrawn:—

No. 181.—The Cleansing of Water Courses.
" 220.—Agricultural Holdings Act, 1913.
F.P. 15.—The Use of Sulphate of Ammonia as Manure.
F.P. 44.—Co-operation and the Supply of Farm Implements.
F.P. 45.—Skim Milk Cheese.
Sp. 75.—The Manufacture of Cheese in Co-operative Dairies.

NOTICES OF BOOKS.

Raspberry Growing in Scotland.—By J. N. Hodge. (Edinburgh: The Scottish Smallholders' Organisation, Ltd., 1921.)—In this little book Mr. J. N. Hodge traces the history of the growth of the raspberry industry in so far as the district around Blairgowrie, in Scotland, is concerned. The writer appears to have been connected with a company which, at the early stages, purchased blocks of land for re-sale to small holders for fruit-growing purposes, and he gives figures showing clearly the cost of the land to the holders, and the return they secured during several years' work. He states that the industry was started over 20 years ago at Blairgowrie, when a farm of 30 acres was purchased and split up into small holdings. From that date the history of the industry is traced, and details are given of one or two large holdings, such as that at Essendy, a holding of 400 acres, and that at Aberuthven. The writer concludes from the figures that it was possible for a business organisation to acquire agricultural land for the purpose of small holdings for fruit culture, with results favourable both to the company and to the small holders. By so doing, he says, the capital value of the land has been considerably increased, being sufficient to employ an increasing number of workers and bringing greater prosperity to the rural population. Ultimately the prosperity is shared by the railway companies which transport the goods from the district, and by the tax collector, who increases his assessment of the land, which is now used for market garden purposes.

Not the least interesting portion of the book is the chapter dealing with the gathering of the crop. Before the War the work was done principally by tramps, who came into the district at stated seasons and did the work moderately well without requiring the grower of the fruit to make any provision for his reception; for he slept, as was his custom, on the roadside or in the woods. In the first year of the War, however, the tramp failed to return; other provision had to be made, and the task proved unduly heavy. A big organisation had to be placed on foot to secure workers from every possible source, taking women and children from the slums of large cities, boys from Industrial Schools, and other war workers of any class or sex who were willing to do the work; even German prisoners were engaged to help. Having secured the supply it was a big task to arrange for the sleeping and feeding of such a large number of people, drawn from different parts of the country, of various classes, and of both sexes. Mr. Hodge's story of this is well worth reading, and he says: "We worried on through these years, grateful to those who had helped us, willing to take back those who wanted to come, but always looking forward with a great longing to the end of the War and the return of the tramp."

Those who are interested in statistics—yield of the crops per acre from year to year, and the price realised for the fruits—will find much information in this little book. Further, there is food for thought in the chapter dealing with the limitations of the industry, for it appears from the Blairgowrie experience that where a block of land is planted to any one crop continuously the yield is influenced both by soil limitations and ravages of insect pests. The yields per acre at Blairgowrie have steadily declined; areas that in 1909 were yielding a crop of 2,600 tons produced only 1,500 tons in 1919, and between those years the decline was persistent and gradual.—H.V.T.

Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden. Report 1918-20. With the "Guide to the Experimental Plots."—(D. J. Jeffery, Vaughan Road, Harpenden. Price 2s. 6d. Foreign postage extra.) The Rothamsted Experimental Station, famous the world over, was founded in 1843 by Sir J. B. Lawes, with whom was associated Sir J. H. Gilbert for a period of nearly 60 years. Sir A. D. Hall (now Chief Scientific Adviser to the Ministry of Agriculture) was Director from 1902 till 1912, when Dr. E. J. Russell succeeded him. The period reviewed in the present Report completes the reconstruction which began in 1913. The laboratories have been entirely rebuilt; a library of some 15,000 volumes dealing with agriculture and cognate sciences has been collected; the equipment of the farm has been completed, and cultivations and cleanings necessarily neglected during the War have been carried out.

Rothamsted Methods.—The most important part of the reconstruction, however, has been the reorganising of the work of the Station to bring it more into touch with modern conditions of agriculture on the one hand and with science on the other. The purpose of Rothamsted is, as stated in the Report, to acquire precise knowledge of soils, fertilisers, and the growing plant in health and disease. The work falls into two divisions:—(1) The soil and the healthy plant; and (2) the insects, fungi, and other agencies disturbing the healthy relationships between the soil and the plant, causing disease. The opinion is held at Rothamsted that if farmers are ever to avoid the very serious losses they now suffer from plant diseases and pests, it will be by prevention rather than by cure. The method adopted at the Station is to start from the farm and work to the laboratory, or *vice versa.* There are four divisions in the laboratory—biological, chemical, physical, and statistical. The method differs, however, from that of an ordinary scientific laboratory, where the problem under investigation is usually narrowed down so closely that only one factor is concerned. On a farm such narrowing-down is impossible, and in place, therefore, of the ordinary single-factor method, liberal use is made of statistical methods, which allow investigation where several factors vary simultaneously. For instance, in crop investigations a large number of field observations are made; these are then treated statistically to ascertain the varying degrees to which they are related to other factors, such as rainfall, temperature, etc., and to indicate the probable nature of their relationship. Thus a complex problem is reduced to a number of simpler ones susceptible of laboratory investigation. It is confidently anticipated that this method will prove effective in bringing the full help of science to bear on the farmers' problems.

Fertiliser and Soil Problems.—The War has profoundly modified the artificial fertiliser position. Extensive factories now manufacture nitrogenous fertilisers from the air. Of these, nitrate of lime, nitrate and muriate of ammonia, and nitrolim have been or are under investigation at Rothamsted. A further important source of organic nitrogenous manure is sewage, and a new method of dealing with sewage, which has been devised by Dr. Fowler at Manchester, has been tested at Rothamsted, and it is found that a general adoption of the method would add considerably to our supplies of organic manures. Rothamsted is also investigating basic slag. A grazing experiment with sheep, and a set of hay experiments on permanent and on temporary

grass-land, have been started to ascertain the value of modern slags and of mineral phosphates. In addition, an elaborate series of pot experiments is in hand to determine whether any constituent besides the phosphate is of value.

Manures not only increase the crops; they bring about other changes, and these are being examined by the botanical staff of Rothamsted. The effects of manures and cultivations on crop yields are by no means simple or straightforward. Every farmer knows the variations due to season and weather conditions; and although weather may never be controllable, foreknowledge of its probable effects on crops would be very valuable. In order to study these effects, a Statistical Department has been set up to carry out an analysis of the meteorological conditions at Rothamsted in conjunction with the crop records since 1852.

However skilfully artificial manures are applied, it is essential on ordinary farms to add organic matter to the soil. Four ways of doing this have been investigated at Rothamsted. Experiments in the production of artificial farmyard manure have also been made and are being continued. Laboratory work has shown that the breaking-down of the material of straw is brought about by organisms. One of these organisms had eluded all previous investigators, but the Rothamsted workers succeeded in obtaining it in pure culture, studying it freely, and determining the conditions it requires to act.[1]

Experiments at Rothamsted have shown how clover—one of the most difficult crops to grow—can be improved. In another direction, no fewer than 10 workers are engaged on a survey of soil population—those soil organisms, invisible to the naked eye, yet present in vast numbers and in extraordinary variety, without which organic manure would be not only quite useless but in some cases harmful. The ultimate aim of the agriculturist is to control this soil population in much the same way that the animal breeder has controlled and developed the original wild animals. Control, however, is not possible without full knowledge of what the organisms are, what they do, and how they live; and it is this knowledge which the Rothamsted scientific workers are endeavouring to acquire.

Rothamsted's War Work.—The most important War work performed at Rothamsted was begun in 1916, when the food situation was causing great anxiety. This country was producing only one-half of our total food. Worse still, the food produced included more of the luxuries than of the necessaries—for instance, all the highest-quality meat but only one-fifth of the bread. Farmers were therefore called upon to perform a double task: they had to produce more food, and different food; to give us three or four loaves out of every five loaves required, instead of only one out of every five as hitherto; and to do this without causing too-great shortage of milk or meat. The situation presented many difficult administrative, financial and technical problems. How Rothamsted helped to solve the problems involving soils and fertilisers is told in this Report, which should be in the hands of every farmer who is interested in learning what Science is attempting to do for Agriculture.

[1] See this *Journal*, Vol. XXVIII, p. 398.

Agricultural Returns, 1921: Produce of Hops.

THE following preliminary statement shows the estimated total production of hops in the years 1921 and 1920, with the acreage and estimated average yield per statute acre in each county of England in which hops are grown; and the average yield per acre of the ten years 1911–1920.

COUNTIES, &c.	Estimated Total Produce.		Average returned on 4th June.		Estimated Average Yield per Acre.		Average of the ten years 1911–20.
	1921.	1920.	1921.	1920.	1921.	1920.	
	Cwt.	Cwt.	Acres.	Acres.	Cwt.	Cwt.	Cwt.
KENT East ...	**39,000**	49,000	**4,005**	3,258	**9·6**	15·2	11·5
KENT Mid ...	**52,000**	72,000	**5,414**	4,520	**9·7**	15·9	12·2
KENT Weald ...	**52,000**	85,000	**6,634**	5,710	**7·9**	14·8	11·1
Total Kent	**143,000**	206,000	**16,053**	13,488	**8·9**	15·3	11·6
HANTS	**9,000**	10,000	**1,043**	838	**8·4**	11·8	10·1
SURREY	**1,500**	2,000	**196**	172	**7·4**	12·7	8·3
SUSSEX	**13,000**	26,000	**2,269**	1,788	**5·7**	14·6	10·4
HEREFORD ...	**33,000**	23,000	**3,522**	2,993	**9·5**	7·7	7·7
WORCESTER ...	**24,000**	14,000	**1,963**	1,667	**12·1**	8·3	8·2
OTHER COUNTIES*	**760**	120	**87**	56	**8·7**	2·1	6·3
TOTAL ...	**224,000**	281,000	**25,133**	21,002	**8·9**	13·4	10·5

* Salop, Gloucester, and Berkshire.

Note.—The estimated total production of 224,000 cwt. this year is 57,000 cwt. below that of 1920, when the area was 4,000 acres less, and, excluding the years 1917-19, in which the area was compulsorily reduced to a very low figure, is the lowest recorded since 1909. The total area of 25,133 acres this year includes about 8,000 acres planted after September, 1919, so that nearly a third of the total consisted of young hops not yet in full bearing. The average yield per acre of 8·9 cwt. is 4·5 cwt. less than last year, and 1·6 cwt. below the average of the ten years 1911-20. Good crops were obtained in the western counties, Hereford showing a yield nearly 2 cwt. and Worcester a yield nearly 4 cwt. above the average, but crops were unsatisfactory in the south-eastern counties, notably in the weald of Kent and in Sussex.

ADDITIONS TO THE LIBRARY.

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Ellis, E. T. (Edit.).—Black's Gardening Dictionary. (1,237 pp.) London: A. & C. Black, 1921, 15s. [63.5(03).]

National Institute of Agricultural Botany.—Report of the Potato Synonym Committee, 1920, and Resolutions of the Potato Industry Conference. (18 pp.) Cambridge, 1921, 1s. [63.512(04).]

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"*Matheson, Darley.*"—Cattle and Sheep. A Practical Manual about Breeds and Breeding, Foods and Feeding and General Management. (202 pp.) London: Pearson, 1921, 5s. [63.62(.02); 63.63(.02).]

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Guthrie, E. S.—The Book of Butter: Nature, Manufacture and Marketing of the Product. (270 pp.) New York: The Macmillan Co., 1920, 12s. [63.72(02); 63.724.]

Walker-Tisdale, C. W.—Practical Butter-Making. (143 pp..) London: Swarthmore Press, 1921, 5s. 6d. net. [63.72(02).]

New South Wales Department of Agriculture.—Science Bull. 20:—Dairy Factory Premises and Manufacturing Processes. Application of Scientific Methods to their Examination. (40 pp.) Sydney, 1921. [576-8: 7; 63.70(04); 63.718.]

Canada Department of Agriculture.—Bull. 325:—Dairy Barns. (34 pp.) sioners' Series. Bull. 57:—Simple Methods for the Storage of Ice. (8 pp.) Ottawa, 1920. [664.8.]

Engineering.

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Binnie, Sir A. R.—Rainfall Reservoirs and Water Supply. (157 pp.) London: Constable, 1913, 9s. [628.7.]

U.S. Department of Agriculture.—Bull. 906:—Use of Concrete Pipe in Irrigation. (54 pp.) Washington, 1921. [63.13; 698.]

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 9.

DECEMBER, 1921.

NOTES FOR THE MONTH.

Breeding for Milk.

It is perhaps late in the day to press upon the attention of dairy farmers in this country the many advantages which may be derived from systematic milk recording. The progress already made since the Ministry initiated its recording scheme in 1914 is remarkable,* but further developments are already in sight, and in publishing the articles on milk recording in Denmark in the October and November issues of this *Journal* the Ministry desired to draw the attention of agriculturists to certain features of the Danish schemes which deserve imitation here. It is gratifying to learn that in the first instance breeders in Denmark were guided by knowledge derived from a study of the methods by which British breeds of livestock reached the pre-eminence which they admittedly occupy. In so far as breeding for milk is concerned, however, the pupils may outstrip their masters. Mr. Faber's article brings convincing evidence to show (1) that in the transmission of milking qualities to his progeny the sire plays as important a part as the dam; (2) that while both should have a milking pedigree, ancestral merit alone will not ensure the transmission of milking qualities; (3) that to secure the best results and progressive improvement pedigree should be confirmed by performance. A pedigree bull does not always get good daughters. His true merit can only be judged by a progeny test.

So convinced is the Danish Government of the value of performance as distinct from pedigree, that in making provision for the award of special prizes for bulls, it was laid down that a bull is not eligible for a Government prize unless records of the performances of his daughters can be produced.

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* See the Fourth Volume of the Ministry's Register of Dairy Cows, reviewed at p. 861.

(40115) P.14/35. 11,625. 11/21. M. & S.

Mr. Faber adds an informing fact: " before the inauguration of milk recording societies it had already become a general practice to keep bulls for service for a number of years, and . . . *to judge the bulls by an examination of their offspring.*" On this the natural reflection is: if this is the general practice in Denmark, is there any reason why it should not become general in the United Kingdom? Mr. Faber's paper contains abundant evidence on the capacity of certain bulls to get daughters showing a better performance than that of their dams, and thereby raise the standard of the strain or breed. On the other hand there is good evidence that, on occasion, pedigree bulls get daughters whose performance is not so good as that of their dams, and it is this fact which justifies the progeny tests. A striking confirmation of this will be found in a Bulletin* recently published by the Agricultural Experiment Station, Maine, U.S.A.

The Bulletin in question gives the result of a study of the milk records contained in the Registry of Merit of Jersey Cows published by the American Jersey Cattle Club. The object in view was to place the pedigree bulls concerned in one of two classes (*a*) bulls the performance of whose daughters was better than that of their dams; and (*b*) bulls whose daughters' performances were less than those of their dams. In order to add to the reliability of the results, only those bulls were classified for which the records of two or more daughters (and of their dams) were available. Tables containing the names and numbers of 224 pedigree bulls are published showing the performance of daughters individually, as well as the records of the dams of their daughters. This interesting and important fact emerges. About one half (105) of these bulls produced daughters which on the average gave a higher yield of milk than their dams, while the remainder (119) had the contrary effect: their daughters' performances fell short of their dams. Two examples may be given. The bull named " Hood Farm Torono " is the recorded sire of 34 daughters. In the case of all but five of these daughters, the yields were higher than those of the dams. On an average the net increase on the daughters' yield over that of the dam was 2,620 lb. On the other hand, the records for the bull " Jacoba Emanon " one of the 119 which affected their daughters' yield unfavourably, show that his nine daughters on an average produced 2,190 lb. *less* milk than the average of their dams.

* Studies in Milk Secretion: Bull. 281, Maine Experimental Station, 1920.

These striking results may be expressed in another way. The figures show that one-half of pedigree bulls when classified on the basis of a progeny test got daughters inferior to their dams. That is to say, it was an even chance (before the performance of his daughters was ascertained) whether any one of these bulls would justify his pedigree or his retention for stock purposes.

Similarly, when these bulls were tested by their effect on the butter fat in the milk of their daughters it was found that roughly one-half produced daughters with a higher yield of butter fat than their dams had given. Lastly, when both factors were taken into consideration, total yield and butter fat percentage, only 28 Jersey sires qualified as having produced daughters superior to their dams, in respect *both* of yield of milk and of butter fat percentage. Stated briefly, the evidence from Denmark, confirmed by evidence from America, proves conclusively that breeding for milk based on considerations of pedigree only is unsafe and should be supplemented by the progeny test. That valuable results can be obtained by following considerations of pedigree, the progress made in breeding for milk in this country is some evidence, but a point has now been reached when the test of progeny must be applied if further progress is to be made.

The Ministry already publishes annually a Register of Dairy Cows* officially certified as having yielded a prescribed quantity of milk per annum, and is now considering the desirability of instituting a Register of Dairy Bulls, in one section of which would be recorded bulls having not less than two daughters entered in the Register of Dairy Cows. The benefits of such a register would be lost unless breeders abandon the general practice of slaughtering bulls before the performance of their daughters can be ascertained. Many breeders object, for various reasons, to keeping an aged bull, but none of the objections usually advanced should be permitted to outweigh the undoubted advantages that would result from the continued breeding from bulls which, by the performances of their daughters, have shown that they are prepotent in milk qualities. This, essentially, was the method by which the great breeders of the past, Bates and others, improved the existing beef breeds of cattle. Its extension to the milking breeds offers no difficulties worth consideration.

* See p. 861 of this *Journal*.

Entries at the New Farm Institutes.

WITH reference to the articles on New Farm Institutes which have appeared in this *Journal*, it is of very considerable interest to note that nine Farm Institutes which opened recently have a total accommodation for 269 students, and that 216 students have been already enrolled. Seven of the Institutes have enrolled practically all the students they can accept, and in two cases only has there been a failure to secure students approximating to the maximum number which can be accommodated.

Meetings of the Council of Agriculture for England.

THE 5th meeting of the Council of Agriculture for England took place at the Middlesex Guildhall, Westminster, on 4th October, the Earl of Selborne, K.G., G.C.M.G., being in the chair. Sir Douglas Newton moved the following Resolution:—

"That in view of the sudden and drastic alteration made by the Government in their agricultural policy, they are hereby respectfully requested to make provision for advances on loan, in approved cases, of working capital to farmers who have recently purchased their holdings, on somewhat similar lines to those followed in the case of small holders."

An amendment to delete the words "who have recently purchased their holdings" was moved but not carried; and, in the course of further discussion, Sir Francis Floud, Permanent Secretary, suggested, on behalf of the Minister, the addition of the following words to the original motion:—

"and that the Agricultural Advisory Committee should be asked to appoint a Special Committee of members of this Council to consider whether a sound system of credit can be devised for submission to the Government."

The original motion, with the words added as proposed by Sir Francis Floud, was then put to the meeting and carried.

Mr. German moved the following Resolution, which was carried unanimously:—

"That this Council draws the attention of the Ministry of Agriculture to the hardships imposed upon small farmers by ruling out fractions of an acre in the total claimed for by growers in respect of wheat and oats of the 1921 crops. Since rates and taxes have to be paid on these fractions and labour bills paid for their cultivation, the Council is of opinion that the Ministry has no justification in law or equity for ruling that the 'acre' in the Act of Parliament does not include parts of an acre, and that the only effect of this uncalled-for economy is to deprive these small farmers of sums to which their right has been legally recognised."*

* A copy of the statement on this subject made by the Minister in the House of Commons on 31st October, is given on p. 859.

The Report of the Live Stock Advisory Committee on matters referred to it at the Meeting of the Council of Agriculture on 4th March last, namely, (1) proposed legislation to secure the registration of all bulls kept for service, (2) slaughter of calves, (3) compilation of voluntary register of owners of pedigree herds willing to supply useful class pedigree bulls at moderate prices, to take the place of bulls rejected for the Ministry's Bull Register, was received by the Council.

At a special meeting of the Council held on 22nd November, a Resolution on the subject of the importation of store cattle from Canada was passed by a vote of 47 to 11. The Resolution was proposed by Mr. H. German and seconded by Lord Ailwyn, and ran as follows:—

"That in view of the fact that the Royal Commission on the importation of Store Cattle :—

(1) Declined to consider the question of Imperial policy as regards the food supply of the country in time of war;

(2) Admitted that the importation of Canadian stores would endanger the livelihood of crofters and small-holders in the Highlands, from which it follows that the much larger number of small farmers in the North and West of England and in Wales would also be damaged;

(3) Failed to deal with the question of the importation of live animals from other Dominions or from foreign countries who might claim similar privileges to those proposed to be given to Canada; and

(4) Stated that the possible advantages to the consumer would not amount to more than an uncertain tendency to a slightly lower level of prices.

This Council is of opinion that the existing policy with regard to the importation of livestock is in the best interests both of producers and of consumers on the following grounds :—

1. It provides for the maintenance of our home meat supplies, without the cost of a single penny to the taxpayer or the consumer.
2. It affords the greatest encouragement to the development of stock-breeding and beef-producing in this country.
3. It enables us to supplement these home supplies of fresh meat with any available supplies of fat cattle which Canada or any other country can ship for immediate slaughter.
4. It strengthens our position in the world market and enables us to buy world supplies of refrigerated meat at the cheapest possible price.

The Council, therefore, respectfully urges the Government to make an immediate pronouncement in favour of the maintenance of the present system of requiring imported cattle to be slaughtered at the port of entry."

* *

Payment of Corn Claims.

ARRANGEMENTS for paying the claims under the Corn Production Acts in respect of wheat and oats of this year's crop are now well advanced. With the exception of a small number of cases requiring special investigation, the majority of growers whose claims were received not later than the 18th July have now been notified of the amount payable to them on the 1st January, 1922, and the actual payable Orders will be issued at the end of December.

Claims made after the 18th July were accepted as an act of grace, and on the understanding that payment on the 1st January next could not be guaranteed, but every endeavour will be made to make the payments as soon as possible.

* * * * * *

The Monthly Agricultural Index Number.

THE agricultural index number of the prices of agricultural produce which is calculated each month by the Ministry of Agriculture, shows that the prices at which farm produce was marketed during October in England and Wales were on the average 87 per cent. higher than the average prices for the years 1911-13. This represents a fall of 15 points, as compared with the level of prices ruling in the previous month. In October last year the average level of these prices was no less than 190 per cent. above the average of the three years 1911-13. The following table shows the figures for each month since the beginning of 1919:—

Month.	Increase per cent. on the average of the years 1911-13.		
	1919.	1920.	1921.
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	105
October	166	191	87
November...	182	197	—
December...	207	194	—

Wheat, barley, and oats all declined, and the average price of oats was only 34 per cent. higher than in pre-war days. Live stock, both fat and store, also fell in value, the decline being least marked in the case of dairy cows, which were only slightly lower in price in October than in September, while the average market value of dairy cows in October was fully twice as high

as in the years 1911-13. Dairy produce showed a slight fall, the average price paid under contract to milk producers during October, the first winter month, being nearly 1d. per gallon lower than the September average, owing to the stoppage of the bonus of 3d. per gallon which was paid in some districts during the latter month. Eggs alone among the commodities commonly marketed advanced in value.

Among the commodities purchased by the farmer, milling offals, oilcakes and maize were all much cheaper in October than in September, and other feeding stuffs experienced smaller declines. Nitrate of soda and superphosphate among fertilisers showed substantial reductions in price.

* * * * * *

The Destruction of Injurious Weeds.

THE Minister of Agriculture and Fisheries, in accordance with powers conferred upon him by the Corn Production Acts (Repeal) Act, 1921, has made an Order authorising County Agricultural Committees to act on his behalf in relation to the provisions of the Act requiring the destruction of certain injurious weeds. The weeds referred to in the Act are spear thistle, creeping or field thistle, curled dock, broad-leaved dock, and ragwort, and the Minister is empowered to serve upon the occupier of any land where these injurious weeds are growing, a notice requiring him to cut down or destroy them within a definite time specified in the notice, a copy of which is sent simultaneously to the landlord. Failure to comply with the requirements of the notice is punishable on summary conviction by a fine not exceeding £20 and 20s. for each day during which the default continues after conviction. Proceedings must be instituted by the Minister, who shall be entitled to execute the destruction work specified in the notice and recover the cost from the offender. As regards public roads, it is held that the authorities responsible for their maintenance shall be regarded as the occupier for the purpose of the destruction of weeds.

* * * * * *

Value of the Poultry Industry.

THE Minister attended the Annual Dinner of the Poultry Club on 18th October, and in his speech showed the value of the poultry industry to this country.

In 1920 the United Kingdom imported eggs and poultry to the value of £18,759,656, exclusive of imports from Ireland. Irish exports were valued at £18,236,406 in 1919,

the bulk of which came to Great Britain. Thus the value of eggs and poultry imported into Great Britain during 1920 probably reached the figure of £36,000,000.

The value of eggs and poultry produced in the United Kingdom in 1920 is believed to have been between £50,000,000 and £60,000,000, whereas the estimated value of the wheat crop in the United Kingdom for 1920 was approximately £31,000,000.

* * * * * *

Olympia Agricultural Company's Research Department.

THE first annual report of the Research Department of the Olympia Agricultural Company has just been issued. This Company, it should be explained, has been formed with the object, mainly, of conducting a purely farming business on the most advanced lines. It is the owner of 10,000 acres of farming lands distributed throughout the Kingdom. The headquarters are at Offchurch Bury, near Leamington, where the Research Station is situated. A unique feature of the enterprise, however, is the recognition of the advantages that are likely to be gained from scientific knowledge and research when applied to agriculture. The report relates to the activities of a staff of scientific men who, under the direction of Dr. Crowther, late Professor of Agricultural Chemistry at Leeds and a well-known authority on nutrition, are engaged in original research in fully-equipped laboratories in Offchurch, Bury. It must not be thought, however, that the Company's motives are merely selfish. The intention is that such good as may result from the labours of the scientific staff shall be freely available to all, and advisory services are also offered free of charge to agriculturists. In this first report, naturally, one does not expect to find more than a record of the commencement of investigations. Sufficient is stated, however, to justify confident anticipations for the future, particularly in relation to plant breeding, for the Company has been fortunate in securing the services of Capt. H. Hunter, whose success in plant breeding under the Irish Agricultural Department was noteworthy—especially in relation to barley. There has been no precedent for such enlightened enterprise since Sir John Lawes founded the world-famous laboratory at Rothamsted. If the Offchurch, Bury, station achieves even a tithe of the success of its predecessor, the agricultural community will have good cause for gratitude.

THE WORK OF THE ROTHAMSTED EXPERIMENTAL STATION, 1918-20.*

E. J. RUSSELL, D.Sc., F.R.S.,
Director, Rothamsted Experimental Station.

THE object of the Rothamsted Experimental Station is to obtain precise information about soils, fertilisers and the growth of crops in health and disease, and to put this knowledge into such a form that it can be used by experts, teachers and well-trained farmers. The work is carried out partly on the farm and partly in the laboratory, with the pot culture house as a convenient bridge between them. No positive recommendations would be issued to farmers on the basis of pot culture work alone, because experience has shown that results obtained in pots may differ from those in the field; but the method is of great value to the investigator in enabling him to sort out the more promising materials or possibilities with a view to trial on the larger field scale.

The Work on the Farm.—The purpose of the farm experiments is:—(1) To increase the growth of crops; (2) To increase the health or vigour of the crop; and (3) To reduce the cost of production.

Increased growth of crops can be brought about by the proper use of artificial fertilisers; but by themselves fertilisers would not suffice, and farmers at any rate are not likely to forget that other factors are equally necessary. At Rothamsted constant stress is laid on the need for:—

(*a*) Good cultivation, drainage and freedom from weeds;
(*b*) Ample supplies of organic matter;
(*c*) Sufficient lime to ensure freedom from sourness; and
(*d*) Sufficient artificial fertilisers of the right kind, given at the proper time and in the proper quantity.

Cultivation (with which is included drainage) is the most important of these for two reasons: without proper cultivation it is impossible to keep down weeds or to secure a satisfactory water supply, and unless it is well carried out all efforts to increase crop production are likely to fail. The introduction of the tractor has profoundly changed our ideas of what is possible in the way of cultivation, and we do not yet know exactly what can be done even with our present implements, while the enterprise of some of the makers is perpetually leading to new modifications in the implements

* For an account of the earlier work *see* this *Journal*, Vol. XXVI., pp. 497–507.

themselves, which still further extend the possibilities. Broadly speaking, the effect of the tractor has been to speed up all operations so much that work can now be done as a general rule that formerly could only rarely be attempted. Certain processes carried out at Rothamsted are described below.

Autumn Cleaning of Stubbles.—Very marked benefit has resulted from the cleaning of the stubbles which was carried out at Rothamsted in the autumn of 1919, 1920, and during the present year. Corn crops, as every farmer knows, are liable to infestation by weeds, and the stubble is apt to contain quantities of weed seed. At the same time there is often sufficient moisture in the soil at harvest time to allow the germination of weed seeds *if the surface is broken up directly the crop is cut*, but the moisture is rapidly lost if the land is left bare and unworked for a short time. So long as horses only were available it was impossible to carry out the necessary cultivation quickly enough, but with the tractor the requisite speed is obtainable and the land can be broken up. As an example, Harpenden Field of 30 acres, on the Rothamsted farm, had carried several corn crops during the War and was very weedy in 1918; the weeds, however, were much reduced by the stubble cleaning carried out with the tractor during and just after the harvest of 1919. Wheat was sown in October of that year and its stubble was cleaned in 1920; wheat again was sown in 1920 and remained to the end fairly free from weeds. The bare fallow or root crop that would have been necessary in the old days was dispensed with, and sufficient cleaning was effected in the autumn to bring the land back to a satisfactory condition. It is now hoped to be able to deal with the most serious of all the farm difficulties at Rothamsted—the Broadbalk wheat field—which has carried wheat continuously since 1843 and is distinctly foul. Messrs. Ransomes, Sims and Jeffries have lent a broadshare that can be worked by the tractor, and it is hoped that this will cope with the serious weeds on this field: it certainly made good work in breaking up the surface soil and cutting off the existing weeds.

The second great advantage of the tractor is that it allows of subsoiling. Experiments during the past four years have shown that subsoiling increases the crop of potatoes by about 10 cwt. per acre, and also benefits the following wheat crop. Experiments made elsewhere show much greater gains from subsoiling wherever a plough sole has been allowed to form—a common occurrence on the heavy lands of Essex.

Time of Sowing.—A further advantage of the tractor is that it enables cultivation to be pushed forward so rapidly in autumn as to allow winter corn crops to be sown early. There is no advantage in sowing too soon, but experiments have shown that on the Rothamsted land winter oats should go in during the first fortnight in October, and winter wheat during the second fortnight. With horse cultivation it was impossible to be right up to time, and the result was a certain proportion of poor corn crops which became badly infested with weeds.

Chalking.—It is also found that the work of the tractor on heavy land can be considerably lightened by the use of chalk.* One of the fields is divided into three parts, two of which are chalked and the third unchalked. A dynamometer was attached to the tractor as it was hauling the plough across these strips. On the unchalked land the draw-bar pull was 1,610 lb. for three furrows, and the speed per hour was 1.98 miles; as soon as the plough entered the chalked strip the draw-bar pull fell to 1,425 lb. and the speed of working increased by 1 mile in 5 hours. This reduction in draw-bar pull means a considerable reduction in fuel and in wear and tear, while the additional speed is a valuable asset.

Cultivation Implements for the Tractor.—The cultivation implements in common use were designed for the horse, and it by no means follows that they are equally suitable for the tractor, which is a very different agent. The ordinary trials are not entirely satisfactory from the farmers' point of view; they are rather artificial. In practice cultivation is carried out to facilitate crop production, and the final test of the efficiency of a machine is the help that it gives to crop growth. At Rothamsted an attempt is made to carry out the test to give the farmer this information; the work of the implements is carefully observed over the whole of the growing period of the crops. The advantage of this plan is that farmers have an opportunity of seeing the implements at work under practical farming conditions, and of judging the value of the work from the growth of the crop, which is after all the best criterion. Some of the largest and most important implement makers are co-operating and lend their implements free of charge.

Supplies of Organic Matter in the Soil.—Recent experiments emphasise the importance of having ample supplies of organic matter in the soil. Some of the older agricultural chemists tended to the view that artificial fertilisers were the chief source of fertility and that little more need be done if

* This *Journal*, August, 1921, p. 419.

sufficient amounts of these were added. It is now known that the full action of artificial manures is exerted only when the conditions are satisfactory for the growth of plants. Organic matter as supplied by farmyard manure improves the conditions for the root crops, facilitating the production of tilth and increasing the water-holding capacity of the soil. It also improves the growth of clover. At Rothamsted recently it has been shown that farmyard manure causes less variation in yield from year to year than does artificial manure; further its use involves less risk of deterioration of soil when the course of cropping is abnormal. In the Broadbalk wheat field many of the plots have received a manurial treatment deliberately deficient in one or more essential constituents; in all the continuous growth of wheat may be regarded as abnormal cropping. In consequence soil exhaustion in most plots is manifested by a progressive diminution of the yield; the actual diminution is, of course, irregular owing to the varying seasons, but from a long series, such as that furnished by the Broadbalk experiment, comparable figures may be obtained representing the mean value by which the yield, in bushels per acre, decreases in each year; these figures measure the mean annual diminution. This result is set out in Table I, where the results of continuous wheat growing are given. *See* also Fig. 1.

Table I.—Comparison of Farmyard with Artificial Manures (R. A. Fisher). Broadbalk Field. Continuous Wheat.

Plot No.	Treatment.	Average yield, bush per acre, 1852–1920.	Mean annual diminution, bush. per acre	Percentage of relative variance ascribable to weather.
2b	Farmyard manure, 14 tons annually	34·519	·031	2·78
3 and 4	No manure	12·269	·097	6·20
5	Complete mineral manure	14·180	·090	5·84
6	As 5 + single Ammonium salts	22·581	·141	6·01
7	As 5 + double Ammonium salts	31·367	·144	5·11
8	As 5 + treble Ammonium salts	35·694	·092	4·18
10	Double Ammonium salts alone	19·504	·157	11·10
11	As 10 + superphosphate	22·046	·219	10·32
12	As 10 + Super + Sulph. Soda	28·319	·181	7·28
13	As 10 + Super + Sulph. Potash	30·209	·123	5·55
14	As 10 + Super + Sulph. Magnesia	27·765	·231	6·38
17 } alternate	Minerals alone, or double ammonium salts alone in alternate years	14·510	·092	10·16
18 } alternate		29·006	·114	4·55

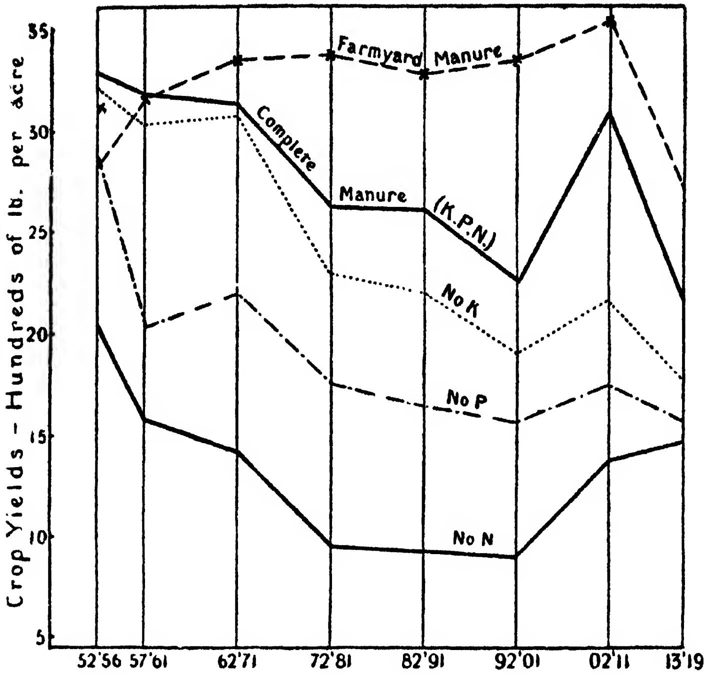

FIG. 1.—Barley yields, Hoos Field, Rothamsted, showing steadiness of Farmyard Manure effects as compared with Artificials.

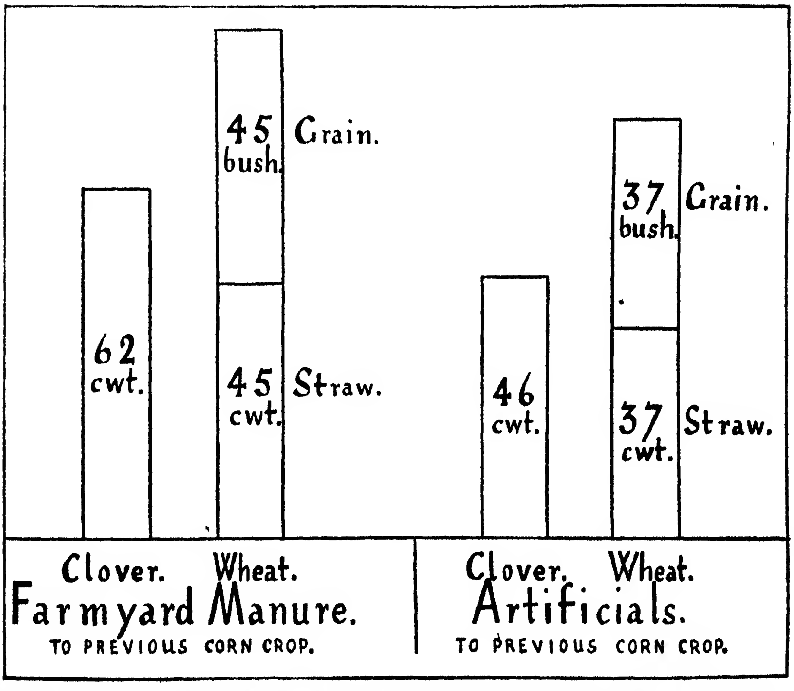

FIG. 2.—Effect of Farmyard Manure and of Artificials on Clover and succeeding Wheat Crop.

The meaning of the result is that farmyard manure is more dependable than other fertilisers, though it is not capable of giving as good yields in favourable seasons as a properly-balanced mixture of artificials.

This is not the place to discuss the scientific reasons for these various effects; a good deal of work is being done at Rothamsted and elsewhere to elucidate them, and until they are fully known it will be impossible to understand completely the best way of using farmyard manure. In the meantime there is another and far more urgent problem: how can the supply of farmyard manure or similar materials be increased?

Two general methods are being studied at Rothamsted. The first, which might be called the anti-waste method, consists in cutting down the wastage from farmyard manure, which is still unfortunately very considerable. The available quantity of manure could be much increased by better making and better storage: both making and storage can be improved by keeping the manure under cover, and by proper adjustment of litter to the amount of nitrogen in the animals' excretions.

Frequent reference has been made in this *Journal* to the necessity for better protection of the manure heap, and farmers realise the advantage of providing this. The question of adjusting the litter to the manure, however, has only recently been studied. It is found that there is a proper proportion of straw to urine, and if this is exceeded wastage results. If the straw is insufficient for the amount of nitrogen in the excretions, some of the nitrogen is lost; while if the straw is in excess, the manure will not "make" properly and the soil derives less benefit than it should. Experiments have shown that 1 ton of straw can be used for every 100 lb. of digestible protein in the animals' food. As a rule, however, the excretions are too concentrated and some added water is also necessary. When these proportions are maintained, satisfactory rotting of the straw proceeds rapidly, and the losses of nitrogen are at a minimum. Under these ideal conditions manure at Rothamsted has rotted down to half its weight without loss of nitrogen.

The second method consists in actually increasing the amount of farmyard manure or similar substances on the farm. This could be done by increasing the head of live stock on the farm, assuming the economic situation justified such a course. Farmers are thoroughly familiar with this possibility and it need not therefore be further discussed.

At Rothamsted considerable attention is being paid to the possibility of substitutes for farmyard manure. In a recent article in this *Journal** Messrs. Richards and Hutchinson described the work in the laboratories on the decomposition of straw by artificial means, whereby a substance is produced resembling farmyard manure. The results obtained with this product on the light land at Woking are quite promising, and the method is being developed. The conditions necessary for the decomposition are fortunately obtainable on the farm; they are proper air and moisture supply, suitable temperature, freedom from acidity and the addition of proper proportions of soluble nitrogen compounds.

A second method of increasing the supply of organic matter on the farm is by the use of green manuring. Attempts were made at Rothamsted to develop this method some years ago, but as the only implements then available were those worked by horses it was not found possible to sow a catch crop after the harvest, and without this, green manuring is hardly an economic possibility. With the tractor, however, greater rapidity is possible, and for the last two seasons it has been possible to sow green crops immediately after harvest and to obtain a certain amount of growth before ploughing in. The oats of 1920 grown in this way were an excellent crop.

The third possibility is to obtain manure from sewage. An extensive experiment has been carried out at Rothamsted during the last three years, showing that the new method known as the "activated sludge" treatment gives a fertiliser of high value, very considerably better than anything yet obtained. The method is effective so far as purification is concerned, and yields in addition this useful fertiliser.

The Growth of Clover.—As clover is such an important crop in arable husbandry, it has received particular attention during the past two years at Rothamsted, and the work is being extended. The significance of the crop lies in the fact that it not only yields valuable hay, but greatly enriches the soil in organic nitrogen compounds which markedly benefit the succeeding crops. It is one of the most difficult crops to grow well, and few farmers would claim that they obtain satisfactory yields as frequently as they wish. The difficulty arises from the fact that the plant depends for success on the activity of certain bacteria in its roots, and the conditions must therefore be favourable both to the plant and to the organisms.

* August, 1921, p. 398.

Experiment shows that the clover crop may be benefited by four means :—

(1) Improvement in the method of sowing, to give the seedling a good chance of establishing itself;
(2) Dressing of ground limestone or chalk;
(3) Application of phosphates, and, where necessary, potash before sowing;
(4) The use of farmyard manure.

In some of the Rothamsted experiments the weights of the young plants at the time of cutting the barley were:—

	Young clover plants. (cwt. per acre).	*Barley.* (cwt. per acre).
No manure	4·8	21·2
Slag and lime	6·7	31·7
Superphosphate and sulphate of potash	11·2	26·1
Farmyard manure	10·3	28·2
Superphosphate and farmyard manure	15·0	26·5

The effect of farmyard manure is so important that it is being studied in detail in the bacteriological laboratory: so far the results indicate that some of the constituents of farmyard manure have a special action on the organisms in the nodules of the clover roots. For other results see Fig. 2.

Sufficiency of Lime.—Farmers throughout the country realise the necessity for applying lime to their soil, and frequent inquiries are made at Rothamsted as to the proper amounts to use, the relative advantages of lime and limestone, etc. Laboratory methods have been devised to enable agricultural chemists to deal with inquiries of this kind, and attempts are constantly being made to improve upon them. At present chemists can advise farmers only in a general way as to the need for lime, and it rarely happens that a reliable, straightforward recommendation can be made on the basis of analysis alone.

The Proper Use of Artificial Fertilisers.—When cultivation has been properly done, sufficient farmyard manure or proper substitute applied, and adequate care exercised in the selection of suitable varieties of crops, then the farmer can hope to derive the greatest possible benefit from artificial manures. It is, however, necessary for him to know three things :—(*a*) the proper mixture to use, (*b*) the proper amount to apply per acre, and (*c*) the best time for application. Nothing short of direct field experiments gives the necessary information,

and it is by no means easy to discover the proper mixture. Years ago it was thought that the problem could be solved merely by ascertaining the ash constituents of the plants and making up a manure corresponding thereto; it is now known that no such short cut is possible. A competent chemist could prepare no fewer than 6,000 different brands of potato fertiliser, each useful under certain conditions. Field trials alone enable one to decide which of all these is the best in any given case. In practice it would be impossible to test them all; it is also unnecessary, since there are certain guiding principles which give a very fair idea of the type of fertiliser needed. Prolonged field experiments are needed to establish these principles, but in the end this is the shortest method of procedure, since without this knowledge we can do little but guess the proper mixture to use. It is not possible to make a short and simple summary of the results, but a discussion of them from the farmers' point of view is given in the writer's "Manuring for Higher Crop Production."*

The proper amount to apply can be determined only by experiment, and this has proved more difficult than was expected. It was at first thought—the idea was started by the famous German chemist Liebig—that the larger the dressing of manure the larger would be the crop; or in other words, that, up to a certain point, the crop yield was proportional to the quantity of manure added. It was subsequently found, however, that this was not the case. The next idea came much later from another German chemist, Mitscherlich; it is to the effect that fertilisers exert their greatest action when used in small quantities, and that they show less and less action as the dressing increases. This, if true, would justify low farming as being the most likely to give maximum profits. The Rothamsted experiments indicate, however, that this is not correct. The effect of small dressings is found to be less than that of larger ones; the most profitable procedure therefore is to use moderately large dressings rather than too small a quantity of artificials per acre. A bold policy is probably best.†

The question of the size of the dressing, however, is inti-

* Cambridge University Press. 1917.

† This result is at variance with one that has been obtained in the United States of America. Prof. Warren, of Ithaca, informs the writer that farmers there obtain good results, and he is inclined to think their best proportionate results, from such small manurial dressings as 4 lb. nitrogen (equivalent to 20 lb. sulphate of ammonia), and 20 lb. of phosphoric acid (170 lb. 26 per cent. superphosphate) per acre. The cause of these differences would form an interesting subject of inquiry.

mately bound up with the time of application. Many farmers are too late in their application of top dressings to cereal crops, delaying until the plant has passed the stage when it can make full use of the material supplied; it then develops a dark green growth liable to rust, and a straw that tends to lodge. The figures obtained at Rothamsted are:—

Increase in wheat crop, 1920, from spring dressings of sulphate of ammonia and superphosphate.

	Grain—bushels per acre.			Straw—cwt. per acre.		
Date of application of manure.	Feb. 10.	March 6.	May 10.	Feb. 10.	March 6.	May 10.
Single dressing ...	Nil	0·9	2·7	2·7	6·9	9·4
Double dressing ...	7·0	—	3 7	11·7	—	12 7

The single dressing gave no appreciable increase in grain and only a few cwt. of additional straw, while the double dressing gave no less than 7 bush. of grain and 12 cwt. of straw when applied at a safe and suitable time. In view of the great practical importance of this work arrangements have been made for continuing it on a larger scale.

Diseases of Plants.—No reliable estimate can be made of the losses of farm crops due to disease, but they must be considerable. It is improbable that farmers could adopt the individual treatment accorded to plants by gardeners; other methods must be sought. Some diseases are due to insects, some to fungi or various other causes. Separate laboratories are being set up at Rothamsted for the study of insects and fungi, but no detailed account of the work can be given as it is still in its early stages and has not yet developed sufficiently to justify application on the farm. In the entomological laboratory Dr. Imms is trying to ascertain what substances will attract insects. Beer and cane molasses proved very effective as baits for traps; ordinary alcohol was of little use. When, however, alcohol was mixed with a small quantity of acetic, butyric or valerianic acid it became highly attractive. Other work in this laboratory relates to the common bean aphis. This insect goes through a remarkable life history, and it spends part of its time on plants such as shepherd's purse, docks, &c., which occur on most farms in sufficient quantity for the purpose. Different varieties of beans vary in their susceptibility to attack, and the possibility of finding or

producing varieties which would be relatively immune to this pest is being investigated. In the mycological laboratory important work is being done on the killing of fungus spores and on Wart Disease of potatoes.

Work for the Future.—In the foregoing account reference has been made only to problems of immediate interest to farmers. At an Experimental Station, however, it is always necessary to look to the future and to conduct investigations which, while of no immediate practical application, show possibilities for the future.

Some of the most interesting work is in connection with the population of micro-organisms inhabiting the soil. The farmyard manure and the green manure put into the soil are not really agents of fertility, but only raw materials out of which fertility is manufactured. The work is done by myriads of micro-organisms, some useful to the farmer, some not, many of them taking their toll of the valuable plant food in the soil. The nitrates they make are indispensable for the growth of plants, but some of them seem to take up nitrates themselves and thus compete with plants. At Rothamsted enough nitrate was produced on one plot in a single day to produce a 5-qr. crop of wheat, but it had all been removed—presumably taken up by organisms—before the end of the day so that the farm gained no advantage from the process. With fuller knowledge it may be possible to control this population and make it serve the farmer just as horses, sheep and cattle do; but we are a long way from that yet.

Finally, an attack is being made on a much more difficult problem. The growth of a crop is like the movement of a motor car; it cannot progress without a continuous supply of energy. In the case of the growing crop this energy comes from the sunlight. The plant as we grow it is not a very efficient transformer; a crop of wheat in England utilises only about *half of one per cent* of the energy that reaches it. During the last 80 years the growth of plants has been improved, thus increasing their efficiency as utilisers of energy, but we are still far from the 35 per cent. utilisation which the motor engineer has attained. Whether such high utilisation is possible cannot be said, but it is important to try any methods that seem to offer hope of advancement. Careful tests have been made of the effect of high tension electric discharge on crop growth; of the electrical and other treatment of seeds; of the effect of radium ores; of stimulating substances such

as boric acid; and of other plans which have been proposed for improving crop growth. Some of these offer a certain amount of promise, others do not; none of them is yet in a stage to recommend to farmers. In reporting on these new ideas it is often necessary in fairness to the farmer to insist that they are not yet ripe for practical application. Yet it is always hoped that inventors will not be discouraged but will go on and try again, for it is only by steady and persistent effort in face of repeated failure that success will finally be attained, and that agriculturists can hope to make progress comparable with that of engineering and of the chemical industry.

IMPERIAL FRUIT SHOW.

DESCRIPTIONS have been given in articles in previous issues of this *Journal* of the manner in which the Ministry and the Horticultural Industry generally have been co-operating with the "Daily Mail," in order to secure the successful organisation of this great Show, which was held at the Crystal Palace from the 28th October to 5th November, 1921. The Show was formally opened by The Rt. Hon. Sir Arthur Griffith-Boscawen, M.P., Minister of Agriculture.

Sir Arthur Griffith-Boscawen, in opening the show, said that probably never before had there been such a show of fruit in the history of the world. He wished at the outset to recognise the energy, the generosity and the support of the Proprietors of the "Daily Mail" in enabling the Exhibition to be held. He recognised that the "Daily Mail" had performed a great Imperial service. Continuing, the Minister said: "The history of the Exhibition is this. We at the Ministry and the principal commercial fruit growers have been anxious for some time to improve and extend the cultivation of fruit in this country. For that purpose a number of local exhibitions in the principal fruit-growing districts, especially at Maidstone in Kent, Worcester in the West Midlands and Wisbech in the Eastern Counties, have been held in recent years, and those exhibitions have done a great good in bringing the growers together and letting them compete against each other, but it was thought there should be something bigger than these exhibitions, that the persons in these districts should not compete merely

against each other, but that districts should compete, and we were organising such an Exhibition when the " Daily Mail " came along and suggested something on an even bigger scale, and that was The Imperial Fruit Show. To-day we have an Exhibition not only of the British Isles but of the Empire. I wish more could be represented, but as it is our Empire exhibits are chiefly from Canada, our oldest Dominion. It would have been better if South Africa, Australia, and Tasmania could have competed, but they are in the Southern Hemisphere—their spring is our autumn—and it is impossible, therefore, to arrange such an exhibition. Here, at all events, you will see the very best of the Old Country competing on even terms with the best of the great New Country—Canada.'

" The Exhibition here is a very remarkable one. Ten thousand packages of apples from the United Kingdom and Canada. Three thousand pounds worth of prizes. Exhibitions in Packing and Grading, and Cider Making Demonstrations. All these we can see here, and there is a great deal to learn."

" I am here to open this Exhibition as the responsible Minister of Agriculture. I am Minister for a great many things, including horticulture and fruit growing, which form an indispensable part of the great industry of agriculture. We realise that horticulture is a most important department of the Ministry of Agriculture. First of all it is the class of agriculture where you get the most intensive cultivation, and where you get the very best possible out of the land. It employs people possessing a great deal of skill and technical knowledge, and is therefore a very highly specialised industry. Secondly, it employs the greatest possible amount of labour on the land, and one of the most important things at the present time is the keeping of the people on the land. Thirdly, horticulture—fruit-growing—produces very necessary articles of human food. ' An apple a day keeps the doctor away,' and the more we consume the better for the health of the community. What I want to see is this: not only more apples consumed but more fruit generally. I also want to see more fruit grown here, and the fruit that we cannot grow here I want to see imported from the British Empire and not from foreign countries."

" The latest figures* give an area of about 220,000 acres under fruit. Of that area 150,000 acres grew apples. We might estimate the apple crop at about 450,000 tons, but,

* In England and Wales.

during the year ending 30th September, 1921, we imported 267,000 tons, the greater part of which was imported not from the British Empire but from foreign countries. I want to see a greater production here and a greater consumption, and I want to see imports drawn from within the British Empire. I want to see Britain and the British Empire as self-supporting as possible. Now the fact is that for many years we neglected fruit-growing in this country, but now I am glad to say we pay more attention to it."

"A good many years ago (in 1904) I was appointed chairman of a committee to inquire into the fruit industry, and we recommended at that committee a special department of the Ministry of Agriculture to deal with fruit. We now have that Department, and in Mr. W. G. Lobjoit and Mr. H. V. Taylor, the Controller and Deputy Controller, I possess two of the most efficient officers that any Ministry can have. We recommended an advisory committee. We have it, appointed by the leaders of the commercial fruit growing industry. We recommended also a committee for the scientific side of horticulture for looking into insect pests and how to overcome them. We have now the Pathological Laboratory at Harpenden, the Research Stations at Bristol, East Malling, the Lea Valley, Campden, and other places, and important work is being done at all these Stations. It was recommended that we should pay more attention to packing and grading, and there can be no doubt about it that we lose a great deal by not attending to that matter. If only our growers will pay more attention to grading and packing they will be able to supply the home markets in this country much more regularly than they do, and the public will buy more apples than they do at present."

"Another point is, that though we grow the very best apples we grow too many varieties. We want to standardise, so that we can send up week after week large quantities of apples alike in type and character. I am not asking for legislation. I do not think legislation is required, nor do I think my advisers in the Horticulture Division would advise legislation. It is by educating the public opinion and by scientific analysis of things that the trade will learn and the light will spread. Lastly, we said there must be more facilities for obtaining land on terms fair to the owner and to the market gardener for this purpose in this country. Last year I had a share in the Agriculture Act and the adoption in it of what is called the 'Evesham Custom.'"

The Exhibition was visited by H.R.H. Prince Henry, who displayed great interest in the exhibits of apples, in the demonstrations of grading and packing, and cider making. Representatives of many other countries visited the Show, notably those from Egypt and Holland.

Judging.—The judging of competitive exhibits of fruit, even when a few judges only are engaged, is at all times a somewhat difficult matter, and the employment of a large number of judges such as was necessary in the case of a show of this magnitude rendered it necessary to lay down certain rules for their guidance, in order to secure uniformity of judging. Each judge was supplied with a score card on which to record the marks awarded to each exhibit. The score card read as follows:—

Fruit.—Best commercial size	10
Colour, finish, skin quality	15
Condition:—Soundness, firmness, freedom from blemish, flavour quality of apple	25
Uniformity of colour and size	15
Packing.—Quality of pack	30
General appearance of entry	5
	100

The work of the judges was organised by Mr. H. V. Taylor, Deputy Controller of Horticulture, who asked the judges to accept the term "best commercial size" as the size normal to the variety. The judges were also asked not to award extra points for any colouring which might have been specially developed for exhibition purposes. It will be observed that the score card includes the expression "flavour quality of apple." This is a unique feature in a British score card, but its importance is so great that its omission in the past is not easily explained.

The work of judging occupied three days, and on account of the high standard of many of the exhibits the task was extremely difficult, and in many cases before a decision could be reached it was necessary to turn the apples out of their boxes. It is very satisfactory, however, that in every case with one exception a decision was arrived at by the judges themselves. The one case on which an agreement could not be reached was in Class II of the British Empire Section. The first prize in this section was awarded by the judges, but on

the second prize a sharp division of opinion arose. The class was judged by three English and three Canadian judges. Failing agreement between the judges, the matter was referred to an umpire.

The list of prize winners is particularly interesting and instructive to all who are interested in apple growing, but space will only admit of the inclusion here of the awards in the British Empire Section.

British Empire Section.

Class I. 20 boxes of any dessert variety.

1st prize. H. A Whiffen, Hownhall, nr. Ross, Herefordshire. (*Cox's Orange Pippin.*)

2nd „ Robert Stark, Creston, Br. Columbia. (*Cox's Orange Pippin.*)

3rd „ Okanagan United Growers, Ltd., Vernon, B.C., Canada. (*Jonathan.*)

Class II. 20 boxes of any culinary variety.

1st prize. Spalding and District Bulb Growers' and Market Gardeners' Assocn., Spalding. (*Newton Wonder.*)

2nd „ Hubert M. Cobb, Cathedral Chambers, Rochester, Kent. (*Bramley Seedling.*)

3rd „ Ontario Fruit Growers' Assocn., Toronto, Ont. (*Greening.*)

It will be seen that the Cox's Orange Pippin, whether grown at home or in Canada, proved supreme as the best dessert apple.

Packing.—Exhibitors were not instructed to use any special pack for their apples, but it was generally anticipated that as this was a commercial show, the diagonal pack would be used for boxed fruit. It is perhaps safe to say that most exhibitors did place the apples on their side, but in most sections apples packed 'eye up' were to be seen, while in the Overseas Sections 'stem up' was the popular pack. A striking feature was the number of examples of the 'off set' pack. This pack displays the fruit to advantage, but unless the stems are properly clipped they seriously injure the sides of the fruit in the box. This injury was apparent even while judging was in progress, and became more prominent towards the end of the Show. Experience alone can decide which pack is the most suitable for British varieties of apples, but there is a general impression that the safest way is to use the diagonal pack, placing all the apples lengthwise.

The importance of size selection to secure a good presentation of the pack is one that should be borne in mind by all exhibitors. This was illustrated by the prize winning exhibits

in which the apples had been selected so that they fitted close together in the pack.

Grading and Packing Demonstration.—At a special stand Messrs. Whiting and Turnbull, two of the Ministry's Inspectors, assisted by Mr. Woods, gave daily demonstrations in grading and the box packing of apples. The demonstration was opened by Lady Griffith-Boscawen, and throughout the Show great interest was taken in this section. Numerous inquiries received made it evident that growers are really anxious to familiarise themselves with this system of presenting apples for market.

Scientific Exhibit.—At another stand the Ministry staged educational exhibits. The section contributed by the Long Ashton Research Station showed the results obtained in fruit breeding by the Station, and the results of investigations into various diseases affecting fruit trees. The chemical analyses of samples of soils suitable for fruit growing were also exhibited. The Fruit Preserving Station at Chipping Campden sent an excellent exhibit of preserved fruit and vegetables, and the technical processes were explained by Miss Watson to numerous enquirers. The East Malling Station dealt with the highly important question of stocks and their influence on the fruiting of different varieties. Exhibits were also staged illustrating the natural habit of growth of the different varieties of apples, and the need for adopting pruning methods to suit the variety and the purpose for which the tree is grown. A valuable section of the Ministry's exhibit was that sent by the Pathological Laboratory at Harpenden. Cases were displayed containing very beautifully produced models of insect and fungus pests of fruit trees. Collectively, the Ministry's exhibit was highly appreciated, and the officers in attendance dealt with a large number of inquiries.

Cooking Demonstration.—Although in Canada there are over 100 recognised ways of cooking apples, in this country the apple appears on the table in only a few dishes. The need for educating the public in the various ways in which the apple can be presented on the table was realised by the National Federation of Fruit and Potato Trades' Associations, who arranged for demonstrations to be given by the Marshall School of Cookery. The demonstration was opened by Lady Floud, who pointed out the necessity for a larger consumption of apples in this country alike in the interest of the public health and in the provision of a wider market for the growers' produce.

Cider Making Demonstration.—The National Association of Cider Makers, in conjunction with Professor Barker, Director of the Fruit and Cider Institute, Bristol University, arranged for daily demonstrations in cider-making to show the general public how this delicious home-made " wine " is produced.

Overseas Exhibits.—Most of the varieties shown were " dual purpose " apples, *i.e.*, they are suitable both for dessert and culinary purposes, Northern Spy and King being notable examples, both of which were exhibited in perfect condition. There were few purely culinary varieties, the principal being " Greening." These dual purpose apples were all of even size, securing a great measure of uniformity. As these apples have been successful in the home markets, it may be necessary for growers to consider seriously whether the great degree of specialisation which in the British Section was manifest by the very large Bramley's and the small Cox's is either necessary or wise.

The whole section had a very pleasing appearance, and was educationally important as demonstrating the value of good presentation.

The amount of interest taken by the public in the Show is instanced by the fact that the total attendance during the eight days exceeded sixty thousand. The Show also stimulated interest in other towns. The National Association of Retail Fruiterers and Florists organised a Shop Window Dressing Competition throughout the country during the week, and the displays must have been of considerable propaganda and educational value tending to increase the consumption of fruit, which was one of the purposes for which the Show was held.

EGG-LAYING TRIALS.

J. W. HURST.

ALMOST a quarter of a century has passed since the inception of egg-laying "competitions," as such, and it is but the bare truth to say that the subsequent remarkable development of the egg producing industry is to a considerable extent the outcome of the idea which originated with Mr. Holmes Tarn, one of the founders of the old Utility Poultry Club, to which practical effect was first given in the autumn of 1897. In that year the first competition in the world was held at Northallerton, Yorkshire, where under the management of Mr. Simon Hunter twenty-eight pullets competed for prizes during a period of sixteen weeks. The beneficial influence of that small beginning in England has since extended to every poultry-keeping country in the civilised world. It may be asked: "What are the benefits that result from egg-laying tests?"—to use the word that has now been generally adopted as being more suitable than "competition."

Improved Stock.—The principal outstanding good, so far as it affects the poultry industry generally, or, in other words, the whole body of poultry keepers, is the gradual, widespread levelling-up of the laying qualities of the stock of the country. This is not to say that unprofitable fowls do not still exist to a very considerable extent, but that the increasing high fecundity that distinguishes egg-laying strains is effecting a gradual but sure improvement in the quality of the stock.

Sittings of eggs, day-old chicks, and pullets, the product of breeding pens specially selected in accordance with records of actual performance, are annually distributed among the general body of poultry keepers to an ever increasing extent. Amateurs who have time and opportunity to engage in breeding operations on their own account are learning the value of the trap nest, and they are moulding their methods on the lines of the more skilled and experienced specialist breeders. In the aggregate this is an influence that is so far-reaching and so important that its ultimate effect cannot be estimated. Nevertheless, at this juncture, after a quarter of a century of testing and comparing we can at least appreciate the tendency by a recollection of the average egg yield twenty-five years ago.

Increasing Facilities.—It is evident that the benefits would not be so generally available but for the continuance of the

tests. Moreover, the tests are in themselves a perpetual advertisement and reminder of the benefits that accrue from strain, in contradistinction to breed. To this end the Press, both daily and technical, has lent its aid ungrudgingly, and in its monthly and annual reports has insistently emphasised the differences that may exist in the egg yield of birds of the same breed or variety, fed and kept in the same way and under equal conditions.

In other words, the value of strain is being inculcated continually in such a way that poultry keepers can hardly remain for long in ignorance of the fact that for egg-production it is a matter of the first importance to secure birds of good strain or proved family fitness. Further, it is by the same means that poultry keepers are enabled to get into touch with breeders of strains of proved prolificness. The published records of egg-laying performance make it possible for the public to compare results, and to familiarise themselves with the names of breeders whose birds are consistent in maintaining a relatively high level of prolificness.

Without the holding of the tests and the publicity given to the results, the public would have no independent check upon the claims of breeders who offer pullets and cockerels, day-old chicks, or sittings of eggs for sale. It is to the egg-laying trials that the public must look for authoritative proof of the reliability of egg-laying strains, and the published records of their tests serve to safeguard the buyers of eggs or birds to a large degree against the unscrupulous advertiser.

Position of Specialist Breeders.—This brings us to a brief consideration of the position of the specialist breeders—those whose work it is to produce and maintain the strains of highly prolific layers. Theirs is a very special and peculiar branch of the industry, the creation and continuance of which depends to a considerable extent upon the holding of egg-laying trials. The tests are to them at once an incentive and an advertisement. Without published records they would have less inducement to keep their stock up to the required level, and without the authoritative character of that publicity their financial rewards might be insufficient to recompense them for their skill and labour.

Egg-laying tests are to the specialist breeders of the egg-laying strains, what the fanciers' poultry shows are to the breeders of standard bred stock; they keep their stock up to the mark and bring them customers. This is, of course, the more directly

commercial influence of the tests, and is of primary importance to those most concerned—the comparatively few specialists. Important as it is to this group of producers it is necessary for others to bear in mind that the whole superstructure of the egg industry is also very directly influenced in the ways briefly indicated. The specialist breeders are essential to the continued development of the industry, inasmuch as they provide the sources of supply upon which the generality of poultry keepers depend, either directly or indirectly, for the maintenance of the prolific strains that serve to level-up the egg yield of the country by improving the character of the stock as a whole.

Essential Safeguards.—It follows from the foregoing that the future of the egg industry must depend very largely upon the safeguards that are imposed, in the form of rules and regulations, by those responsible for the conduct of egg-laying tests. The tests must be so hedged about with what may be called "safety first" rules that the best interests of the industry as a whole—not of the specialists alone—are secured. Any tendency that is seen to be leading to ultimate harm must be checked at the earliest possible moment by the modification of laying test rules and regulations. That this is essential to permanence can scarcely be gainsaid.

At the present time there are two such tendencies that are undoubtedly the cause of considerable anxiety to those who have the lasting interests of the industry at heart. These are signs of weakness in stock, and lack of size in the eggs. Both threaten the future of egg-laying strains and are inimical to the best interests of the industry as a whole. The question of weakness is obviously mainly referable to the breeders most nearly concerned, but the lack of size in the eggs may be very largely remedied by those who make the rules regulating the scores and awards.

It should be sufficiently evident to breeders that the mere maintenance of their strains, and certainly their improvement, is primarily dependent upon stamina and soundness of constitution. Without these essentials the most highly fecund fowls in the world cannot continue to perpetuate their kind, and without some measure of permanence strain-making must fail of its object. That fecundity, vigour, and fertility are not incompatible, is a fact that has been established by experiment under scientific control; and to allow any loss of breeding qualities in fecund strains, as the result of faulty selection, is to court disaster.

Replacement of Dead Birds.—A way has been suggested by which controllers of laying tests may exercise a salutary influence on the maintenance of stamina and constitutional fitness. That is, by refusing to countenance any rule that permits breeders to replace any fowl that dies during a testing period. To permit any such replacement is held to encourage the taking of risks relative to the maintenance of vigour and vitality, and it may quite possibly benefit the breeder concerned in a way that is undesirable—in view of the object of egg tests. Any rule with such possibilities would appear to be quite wrong in principle.

An alternative method, for application in order to avoid penalising a breeder in the event of the death of a bird during a test, was put forward by a speaker at the recent World's Poultry Congress. The method advocated involves the adoption of a different system of calculation, but however satisfactory this might be to the individuals concerned it would seem to evade the main point, which is the importance of imposing checks to degeneracy.

Quality and Size of Eggs.—As regards the prevailing tendency to loss of size in the eggs there is more to be said. There is a very general opinion that it is time to formulate rules and devise means to secure and maintain the desired standard of weight and size in eggs, together with texture of shell and other qualities that, in combination with numbers, are most required. It is equally important, however, to bear in mind that none of these qualities can be maintained, even if they are attained, without the necessary vigour and character in the stock.

As illustrating the wide difference that may exist in weight, mention was made at a conference at the Harper Adams Agricultural College last year of one pen of six birds laying 895 eggs, of which only 14 were under 2 oz. in weight, whereas another pen of six birds laid 939 eggs, of which 223 were under 2 oz. As the 2 oz. egg is the most popular for the breakfast table it is evident (in view of foreign competition) that any method of valuation in laying tests that encourages approximation to this standard is preferable to a method of numerical scoring that would tend to the encouragement of the small egg.

There are those who contend that market value would be the correct standard if pullets were the only egg producers; but as hens in winter are not as a rule highly productive, and foreign imports are greatly reduced, the eggs of pullets secure an artificial value if judged by this standard. It is therefore argued

that the true test of value is the quantity of human food produced, subject to the approximation to standard size. The attainment of the ideal depends upon judgment in selection and mating, the time of hatching, and skill in rearing and feeding.

The need is for numbers, plus quality and standard size. Allowance must obviously and quite reasonably be made for the normal size of pullets eggs (a little below standard requirements), but it is not at all desirable that birds producing a big number of very small eggs should be allowed to win in laying tests.

Regulations for Scoring at Laying Trials.—In this connection it is of interest to note the regulations which govern the award of points for eggs laid at the important laying trials organised respectively by the National Utility Poultry Society in co-operation with the Great Eastern Railway Co. at Bentley, and by the Harper Adams Agricultural College, Newport, Salop.

The National Utility Poultry Society's regulations provide that eggs laid during the first four weeks of the trials, and weighing $1\frac{7}{8}$ oz. or more; during the second four weeks those weighing $1\frac{15}{16}$ oz. or more; and during the remainder of the test those weighing 2 oz. or more, are scored at unit value as *first grade*. Any eggs laid during those periods weighing less than the respective weights fixed for first grade eggs, but not less than $1\frac{5}{8}$ oz. are assessed as *second grade* and scored at unit value. The number of second grade eggs allowed to score for competition purposes is definitely limited, and eggs weighing less than $1\frac{5}{8}$ oz. are not scored at all.

The Harper Adams College regulations provide that for purposes of valuation, eggs will be divided into first grade, to be valued at average market price, and second grade at average market price less 25 per cent. First grade eggs must score 2 oz. or over throughout the trials. During the first 16 weeks of the trials, eggs weighing less than 2 oz. will be assessed as *second grade*, and for the remainder of the trials only those eggs weighing less than 2 oz. but not less than $1\frac{3}{4}$ oz. will be assessed as *second grade*.

The object of these rules is to make due allowance for the normal laying of small eggs in the early stages, but to penalise breeders whose birds do not lay larger eggs within a reasonable period.

Side Issues.—Apart from the main and most important purposes of egg-laying trials, they have already been productive of many results in connection with what may be termed "side issues," that are of a very direct practical value to poultry

keepers as a whole. It often happens that the monthly or annual reports of the various tests contain more or less casual reference to matters of considerable interest, those who conduct such tests being in an exceptional position to make observations on matters affecting management generally.

For example, during the drought this year attention was directed to the fact that a long continuance of dry weather is influential in causing a slight but general falling off in the weight of eggs during the period of high production, but when the rate of production is slower the size is more fully maintained. despite this influence. Again, the fact is emphasised that when penned, the best layers will use up the herbage in their runs more quickly than those that are less productive, thus emphasising the importance of vegetables in the dietary of laying stock.

This latter fact has been further accentuated as a side issue arising out of the inclusion of a section in the eighth Irish egg-laying test, in which the birds were fed on dry mash and grain for the purpose of comparing the productive results with those of birds fed on wet mash and grain. It was found that, whereas the grass in the runs of the latter kept in reasonably good condition, the runs in the dry mash section were quite bare of grass by Christmas (the testing starting on 1st October), and that extra green food had to be given daily to the birds in this section to make good the deficiency.

Many similar instances of the practical educational value of laying tests, additional to the inculcation of the value of strain, could be given, and those who conduct and report on such tests could usefully amplify their notes on the many side issues that inevitably come under their notice, most of which have a more or less important bearing upon the economy of egg production.

Experimental Extension.—Although the testing of strains for prolificness must remain the chief object, there are certain directions in which the work may be extended with advantage, and the Harper Adams Agricultural College authorities are certainly justified in regarding the Male Bird Progeny Test as a natural outcome and development of egg-laying tests. In this direction there is an undoubted need for investigation, to discover the worth of male birds by their breeding behaviour, and the first aim of the College authorities is to obtain definite data from which provisional conclusions may be drawn.

Meanwhile, it may be noted that some interesting results have been secured at the Munster Institute in connection with the tests made by the Irish Department of Agriculture. The Depart-

ment purchased the best pen of pullets in the 1917-18 egg-laying test and mated them with male birds bred from highly-prolific hens, with the result that not one of the pullets reared from this stock laid less than 200 eggs in the first year, one producing as many as 299 eggs. The chief point of interest, however, is the breeding record of the cockerels among the progeny. Four of these cockerels bred the pullets that made up the pens which gained first, second, third, and fifth places at the conclusion of the eighth Irish egg-laying test which ended in August, 1920. Further, the winning pen consisted of six daughters of the champion hen in the 1917-18 test. In the winter following the 1917-18 test the champion hen was mated to one of the males mentioned above, and one of her pullets proved to be the champion layer in the last test with a record of 287 eggs in eleven months—the period of the Irish tests. This pullet finished the year with a total of 309 eggs, and her dam's record was 311 eggs in 365 days.

An extension in another direction is being made in the 1921-22 egg-laying test at the Harper Adams Agricultural College, in connection with which an experimental use of electric light in the houses is to be made in one section. This is a very desirable experiment in view of the several accounts of the successful application of light in inducing a higher egg yield that have been received from America, and the absence of authoritative data in this country.

Whatever is said and done, the fact remains that the primary purpose of egg-laying trials is to prove the prolificness of strains, the value of their produce in respect to the size and quality of the eggs, and the constitutional fitness of the stock—a fitness that is not incompatible with high fecundity. Further, the continuance of authoritative tests is a commercial necessity, and is essential to the progress of the egg industry in this country.

AGRICULTURE BEHIND THE LINES IN FRANCE.

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PART II.—Up to the Armistice, and after.

THE previous article took the reader up to the somewhat tragic termination of the agricultural undertaking in the region of Roye. Before, therefore, dealing with the subsequent activities of the Directorate, after the great German advance in the spring of 1918 had been brought to a standstill, some information as regards the progress of the vegetable garden undertakings, which already existed throughout the area of the British Army, may not be out of place.

As explained in the first article, it had originally been intended that the Directorate should be responsible for supervising all agricultural activities in France. Although, therefore, the main undertaking at Roye had absorbed most of the time and energy of the Directorate's officers, time had nevertheless been found to take stock of all the lesser undertakings that already existed and to afford advice on the subject of the cropping of Army and other unit gardens, and generally to organise the provision of the necessary implements, seeds and manures required.

At the time of the great German offensive, the total acreage of the vegetable gardens in the British Army zone, exclusive of the main undertaking at Roye, amounted to 7,496 acres, of which at least 3,000 acres were devoted to potatoes. Another 7,000 acres had been marked out for cultivation, although operations had not actually been started. A considerable proportion of the above acreage, especially in the areas of the Third and Fifth Armies, and later of the Second Army, was affected by the German advance, but over 4,000 acres still remained in a flourishing condition when that advance had spent itself.

Until the military situation showed some sign of settling down, it was naturally impossible to consider the future of the Directorate, or whether it had any future at all. For the moment, the

possibility of undertaking a new agricultural venture similar to that at Roye was contemplated, and a visit was paid to the rich agricultural country in the vicinity of Orleans, where suitable land could have been obtained. The need for all personnel for work on the lines of defence, and the necessity for the tractors being tuned up again after their long road journey from Roye to Rouen, however, resulted in any further project being abandoned.

In the meantime a new problem had arisen. The German advance on the Amiens front was, as will be remembered, followed by a similar advance on the Second Army front in the neighbourhood of Ypres. As the result of both these advances, the French civilian population was forced to evacuate a large area which it had believed it could occupy indefinitely with safety. This area had in the ordinary course been planted, chiefly with wheat, and in due course would have yielded a rich harvest.

The prospect of a world shortage of food could not be overlooked, and the French Authorities consequently did not view with equanimity the prospect of losing the harvest, even from the 200,000 acres which were involved. They accordingly began to urge on the British Authorities at G.H.Q. the importance of steps being taken to save the harvest in this area, which had now become a *Zone Interdite*.

It was finally decided that the Directorate should not be abandoned, but should be retained in a curtailed form for the purpose of organising the harvesting of this area on a proper basis, and in June the Directorate was instructed to begin operations again. The French Government undertook to pay for the labour of harvesting, to place their interpreters at the disposal of the British Authorities, and to allow the Directorate to use all available agricultural machinery belonging to the evacuated civilian population which could be found in the area. Through the agency of the agricultural officers with each Army, large quantities of this machinery had been salved in the course of the retreat and collected into convenient dumps.

The task, however, was not an easy one. As has already been indicated, the labour supplied in the first instance to the Directorate and formed into agricultural companies had been drafted for operations in connection with the construction of defences, and preparations were by now already afoot for the great Allied offensive which was to terminate in the Armistice of November, 1918. The reconstruction of the Agricultural Companies there-

fore for harvesting operations presented great difficulties, and it was not until the 13th August that it was possible to re-collect sufficient personnel to form two of these companies.

Then again the difficulties of actual harvesting were almost insuperable. Many rich areas were so overlooked by the enemy, that in many cases the work of harvesting could only be done under cover of darkness. Even where the work could be done by day the workers were frequently shelled. Gas, too, was largely used by the enemy, with the result that the use of horses became almost impossible until the affected area had been cleared and the noxious fumes dissipated.

Again, while the corn was young, trenches had been dug, with their belts of protective wire, the whole of which disappeared from view when the corn came to maturity. These naturally proved tiresome obstacles when the cutting of the crop revealed their presence.

The operations were full of incident. On the forward slopes of the Mont-des-Cats—that landmark so well-known to the British troops in France—harvesting was in full progress one night when a heavy hostile barrage was opened on the scene of the operations. The N.C.Os. in charge quickly grasped the situation and, regardless of danger, unhitched all the teams from the machines. Men and horses were taken through the barrage to cover on the other slopes of the hill until the shelling stopped, when work was resumed and the harvesting completed.

In many localities the corn crop extended right up to and in advance of the front line trenches, and even in these cases, in order to save as much as possible, parties of men from units holding the front line voluntarily went out and with any implement that came to hand, severed the ears of corn and sent them in sandbags to selected dumps on the returning ration wagons. No fewer than 150 bags of threshed wheat were saved by this method alone on one Corps front.

One more incident may be recalled. A small area of corn near the front line had to be cleared. The night was pitch dark, and the ground was unfamiliar to the reapers. It was under such observation by the enemy by day that the result of one night's work would readily be apparent to the enemy on the next day and they would naturally take steps to prevent any further harvesting. It was essential, therefore, that the crop should be cut and removed at one cutting. All work had to be done by hand and every sheaf of corn as it was cut had to be carried to waiting wagons, on which it was taken to the back areas to be

stooked and dried. Seventeen men with scythes cut the six acres in three hours—a record that it would be difficult to surpass even by day, let alone under similar conditions.

It was only the devotion to duty displayed by the harvesters on occasions like those referred to that enabled so much work to be done.

Early in August the great offensive began on the Amiens front, and as the advance progressed, the acreage to be harvested increased, with the result that work was continued until late September. The wheat clung to the ear in a remarkable way, and the dry weather in October helped to dry the newly-cut stooks.

The total acreage harvested in Army Areas with the small personnel at the disposal of the Directorate amounted to over 18,000 acres. The whole of the harvest in this area was stacked, thatched and, with the exception of a few stacks, eventually threshed by British labour.

Before leaving this subject, attention is directed to one of the illustrations accompanying this paper (Fig. 8), which shows the actual harvesting operations in progress round a British 6-in. howitzer located in its actual battle position behind the British lines, and therefore liable to be in action at any moment.

The nature of the great British offensive was such as to inspire the feeling that as the Germans were cleared out of the occupied territory, they were being cleared out for the last time. Consequently the way was soon opened for the establishment of another G.H.Q. farm on the lines of that described in the first part of this paper. At the opening of their offensive, the Allies, as is now common knowledge, were inferior in numbers to the enemy, the possibility of another winter in the field had to be reckoned with, and it was desirable that every comfort should be provided for the troops during this period. All this tended to hasten the Authorities at G.H.Q. in their decision as to a new undertaking.

During August careful inspections were made with a view to the selection of a suitable area which could be cultivated with the least interference from the French civilian population. There were many considerations to be taken into account, such as transport facilities, access to supply dumps, and a plentiful supply of water. There were areas in the Department of the Pas-de-Calais which presented many advantages, but few sites possessed such unique features as the site ultimately selected, namely, the triangular plateau lying in the fork of the rivers

Ancre and Somme, east of the point where the two rivers converge at Corbie. The centre of the plateau more or less marked the limit of the great German offensive of 1918, from which they had now been finally forced back.

This area was completely devastated, and the ruined villages scattered all over it offered no inducement to the French inhabitants to return. On the northern side was the broad gauge railway from Amiens to Arras, following the valley of the Ancre, while on the southern side transport facilities were available by barge on the Somme canal. In addition, the area was richly served by trunk and lateral roads, not to mention the military railways which had been utilised for supplies during the year 1917. The French Authorities were willing to allow cultivation to proceed, and under certain decrees passed by the French Government they were able to secure for the British military authorities what amounted to security of tenure.

The flat top of the plateau comprising the area to be cultivated was some 1,500 to 3,000 yards wide and sloped away to the rivers lying to the north and south, either precipitately or in a series of terraces, a formation often found in a chalk country. On the higher portions of the plateau, which was about 350 ft. above sea level, the land was a deep light loam, but on the slopes towards the rivers the soil became shallower and chalk was found at a very slight depth below the surface.

There had been no water on the plateau itself prior to the construction of water points by the Military Authorities, and this no doubt accounts for the fact that all the villages were to be found not on the high ground, but on the river banks, and thus at a much lower elevation. It was doubtless a matter of great difficulty, therefore, for the inhabitants to cart manure from the villages in the valleys, where it was available, to the upper lands.

It is quite certain that the upper lands were suffering from lack of manure. On the other hand, they were eminently suitable for the growing of cereals and roots, such as potatoes and forage crops. Winter wheat had been the rule of the district, and there were many acres of excellent lucerne and clover crops which proved of great value for the horses. Moreover, some of the land had been ploughed for potatoes.

In September the Directorate prepared for renewed operations on a large scale.

They were at this time still located at Le Touquet, whither they had returned after the German offensive had opened. They

continued to retain their headquarters at this point, where a large vegetable garden had been established, partly for experimental purposes, but an advance headquarters was opened early in October in one of the wrecked houses in the square at Corbie, which, as indicated above, lay at the junction of the Somme and the Ancre, at the foot of the hill leading to the plateau.

The area was at once divided into some 9 blocks, each consisting of about 2,000 acres, each in charge of a block commander, who, as a farmer, was responsible for its cultivation. Two of the original agricultural companies were collected and assigned to the work and were reinforced later by at least half of a third company. These companies were distributed over the 9 blocks, so as to ensure that there was a nucleus on each. Their headquarters were located at two dumps situated at suitable distances along the main Corbie-Bray road, which practically bisected the whole area. From these two dumps the block commanders drew all their stores and supplies.

Two Auxiliary (Petrol) Companies (Agricultural) were also allocated and from these were drawn the drivers and mechanics required to deal with the machinery which had been railed up from Rouen. The headquarters of each of these companies was located within a reasonable distance of the railhead, touch being maintained between these companies and the different blocks by motor transport. Apart from agricultural machinery, 280 horses were available and a large quantity of agricultural implements had been salved from the French villages.

The housing for the necessary personnel had to be specially constructed. By this time the British Army advance had penetrated far into the area hitherto occupied by the enemy. The British farm at Corbie was, therefore, one of the only large installations between the base depots and the advancing army. The length of the lines of communication was therefore very considerable, and every effort had to be made to obviate the sending on from the base of heavy stores like huts, except for the use of the advancing troops. Fortunately, the area selected for cultivation contained stores of every kind.

Here was a derelict aerodrome with the canvas of the hangars flapping in the breeze; here was a stranded tank; here an ammunition dump containing shell of any size up to 9-in. or more. Here again were huge collections of empty ammunition boxes.

The construction therefore of suitable hutments both for men and

Photo, Crown Copyright] [*Imperial War Museum.*

FIG. 3.—Harvesting Operations close behind the Fighting Front.

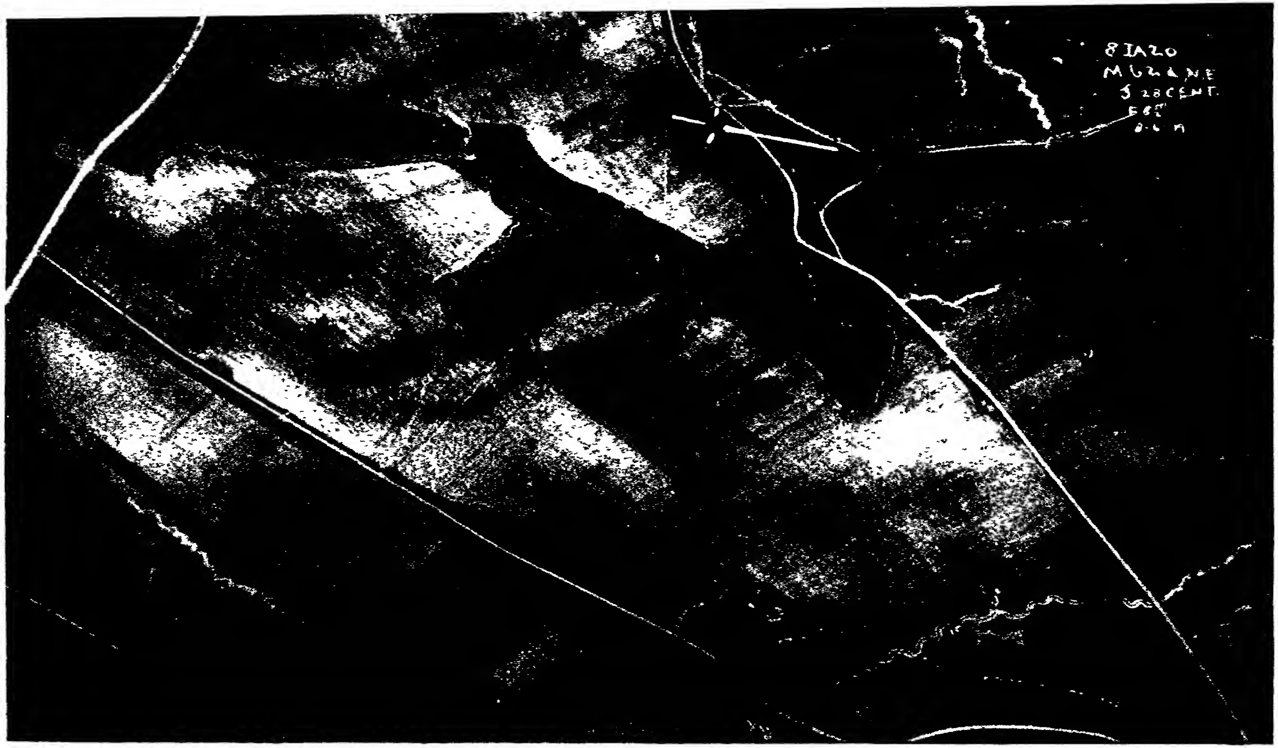

Fig. 4.—An photograph (taken specially for the Directorate by the R.A.F.) showing part of the G.H.Q. Farm area reclaimed, ploughed and planted. The trench system is clearly visible, even where it has been filled in.

horses only required a little imagination. Field-gun ammunition boxes, made to hold 4 shells and their cartridge cases in one, when filled with earth made a very suitable and stable material with which to construct the sides of a hut, and there was no lack of corrugated iron for the construction of the roof.

In a very short time therefore layouts for the various hutted camps were prepared, and construction went forward rapidly, and before long a series of camps was completed, with all accessory buildings, roadways and paths and even, in some cases, adorning shrubs. The importance of these camps will be appreciated later.

The first duty that fell to block commanders was to survey their respective blocks with a view to seeing how much land could be ploughed straight away without any preliminary preparation, and to get tractors put on to such areas without delay. As regards the remainder, the work of clearing was handed over to companies of German prisoners of war.

As has already been intimated, across the plateau, roughly from north to south, ran the front line marking the limit of the German offensive of 1918. Here were two front trench lines with all their reserve lines and communication trenches. Naturally these were somewhat more numerous on the British side of the lines, namely, on the defensive side. Moreover, all trenches were protected by heavy belts of wire of varying thicknesses and there were, in addition, innumerable strong points which were even more heavily protected.

The work of preparing the ground for cultivation did not therefore consist merely in filling in trenches, but involved the tearing up and stacking at suitable points of all the wire and other obstructions which encumbered the ground. Even when the ground had been cleared, the troubles were not at an end. There were many localities in the area where, either on account of the existence of concealed enemy battery positions or suspected dug-out systems, the shelling by the heavy British artillery had been intense. The type of shell used was an armour-piercing variety with a delay action fuse, intended to destroy dug-outs at some distance below the ground level. Where no dug-out existed the shell merely penetrated to a considerable depth and then exploded. The result was that, owing to the depth to which the shell had gone, the force of the explosion merely formed a subterranean cavity of varying dimensions, without leaving a crater on the surface, and a cursory examination of the ground did not reveal anything unusual.

The presence of these shell holes was a great source of hindrance to tractor ploughing. The tractor would proceed without mishap over an apparently untouched area, but as soon as it passed over one of these submerged cavities, its weight proved too much and down it went into the shell hole below the surface, which in most cases was quite large enough to hold the entire tractor, and operations had to be stopped until a detachment of prisoners of war had excavated sufficiently to enable the tractor to be dragged out.

By the middle of October, ploughing was in actual operation but by the end of January, 1919, ploughing more or less came to an end on account of the reduction of available personnel consequent upon demobilisation. By the latter date, however, an area of no less than 6,238 acres had been levelled and prepared for ploughing, 4,000 acres had actually been ploughed, and of these over 800 acres had been sown with wheat. In one area alone there was practically one complete block of about 600 acres of wheat.

Fig. 4 is an aeroplane photograph taken for the Directorate by the R.A.F. in the Field at a height of about 8,000 ft., which shows the ploughed area round a section of trench system, which was subsequently planted with wheat. The trench lines are clearly visible, and the area ploughed is easily differentiated from the area not ploughed. It should be noted, however, that even on the ploughed areas there is a short length of trench line which has been filled in, but is still clearly visible from the air.

The last act of the Directorate before being themselves demobilised was to effect the sale of the whole area to the French Authorities, including huts, tractors, other machinery and tillages, such an eventuality already having been allowed for in the agreement under which the land was originally rented for cultivation. Thus, the Department of the Somme may be said to have been more favourably situated than any other devastated area in France in that here, at all events, over a comparatively small area the inhabitants could be allowed to return to find not only areas cultivated or ready for cultivation, but even rough homesteads prepared for them, in the shape of the hutted camps which had been constructed at various points for the housing of the British personnel engaged.

By the 31st March, the Directorate may be said to have been formally wound up and the demobilisation of personnel completed.

During the period subsequent to the Armistice much had been done by the Directorate in the direction of education. Educational courses were arranged not only on the G.H.Q. farm but also on the various army farms, while some excellent courses on a broader basis were held at certain veterinary hospitals. In addition, demonstrations in tractor ploughing were arranged whenever possible and proved very popular.

Although not an enterprise coming under the auspices of the Directorate, which was not then in existence, no account of the agricultural undertakings in the war zone would be complete without a brief reference to what was generally known as the G.H.Q. Hay Scheme.

In 1917 the Germans began to withdraw to the Hindenburg line and large tracts of land covered with grass fell into the hands of the British Armies. It soon became evident that with a little organisation this land could be turned to good account, and it was therefore decided that as much hay as possible should be gathered to save tonnage.

The area was surveyed and suitable portions were wired in and placed out of bounds to troops, and all available mowing machines were collected from the area. A considerable area of hay proved worth reclaiming, and a detachment of some 200 skilled men were furnished for the cutting operations, while reinforcements of unskilled labour were provided for the actual hay-making. The work started on the 5th June, 1917, and for a week or so the weather was favourable. The last part of June, however, contained at least one wet week, while the latter end of July was continuously wet. Notwithstanding this, 4,688 tons of hay were cut, only 233 tons being subsequently rejected by the Central Purchase Board. The remainder was prime quality.

In conclusion a word of thanks is due to all the French Authorities with whom the Directorate came in contact. No praise can be too great for the help and assistance rendered on all occasions by officers of the French Mission and by the various officials and agricultural officers of the French Civil Authorities, without whose loyal co-operation and sympathy the Directorate would have found it very difficult, if not impossible, to carry out the important work entrusted to them.

THE COST OF HORSE LABOUR.

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SINCE 1908 a great deal of time and attention has been devoted in the Department of Agriculture of the University of Leeds to collecting data as to the costs of production of various farm crops and other produce. Records are available from three farms to 1912; from six farms from 1912-1914; during 1919-1920 eleven farms were being costed right through: and at the present time that number has been increased to thirty-five. On these farms time sheets are in use, so that the amount of labour, whether manual, horse or tractor, expended on each crop or head of stock can be readily ascertained, and monthly records are kept as to the quantity of food—whether home-grown or purchased—that has been consumed by the stock. The farms are visited periodically, monthly wherever possible, and after each visit a monthly summary is sent to the farmer concerned, showing the average weekly cost of upkeep of his cows, feeding bullocks, young stock, working horses, sheep, pigs and poultry.

From the monthly summary of labour he is able to see the number of days his horses are working, and therefore to ascertain readily the average cost of horse labour per working day. The practical value of these costings to the farmer is greatly enhanced if they are given to him periodically and not kept until the end of his financial year. At the end of each year the monthly summaries from each farm are collected and a

TABLE I.

Cost of Horse Labour, 1919-1920. *No. of Farms*, 11. *No. of Acres*, 2,057.

No. of Horses 66.	£	s.	d.	*No. of Working Days 14,278.*	£	s.	d.
Value of 66 horses ...	4,633	12	6	Value of 64 horses ...	4,136	0	0
Purchase of 2 horses ...	106	2	6	Sale of 4 horses	110	10	0
2·1 acres grass	371	16	2	Cost of upkeep of 66 horses	4,028	15	5
75 tons 12 cwt. hay ...	417	12	8				
89 tons 5 cwt. straw ...	243	14	7				
53 tons 19 cwt. roots ..	115	10	6				
444 quarters oats ...	746	19	9				
36 tons 3 cwt. of purchased foods	761	19	4				
Labour	213	6	2				
Incidentals	664	11	3				
	£8,275	5	5		£8,275	5	5

balance sheet prepared, from which the yearly cost of upkeep of various head of stock can be readily determined. When the results from each farm have been thus obtained, the whole results are collected into one table from which the average cost of horse labour, if that is required, over the whole of the farms concerned can be determined for that particular year.

In 1919-20, on eleven farms whose total area amounted to 2,057 acres, 66 working horses were kept, and according to the time sheets these horses were engaged during that period in performing 14,278 days' work.

From Table I it will be seen that during the year 1919-1920 the net cost of maintaining 66 working horses amounted to £4,028 15s. 5d. The detailed summary of the costs is given in Table II :—

TABLE II.—*Summary of Cost of Horse Labour.*

—	Total cost of upkeep per year of 66 horses.			Cost per horse per year.			Cost per horse per week.			Cost per working day.		Percentage cost.
	£	s.	d.	£	s.	d.	£	s.	d.	s.	d.	
Grazing	371	16	2	5	12	8	0	2	2	0	6½	8·8
Hay	417	12	8	6	7	0	0	2	6	0	7	10·2
Straw	243	14	7	3	13	10	0	1	5	0	4½	5·9
Roots and vetches ..	115	10	6	1	15	0	0	0	8	0	2	2·9
Home-grown corn ...	746	19	9	11	6	4	0	4	4	1	1	19·1
Purchased corn ...	761	19	4	11	10	7	0	4	5	1	1	19·1
Total food	2,657	13	0	40	5	5	0	15	6	3	10	66·0
Labour	213	6	2	3	4	8	0	1	3	0	3	4·5
Depreciation ...	493	5	0	7	9	5	0	2	10½	0	8½	12·5
Incidentals	664	11	3	10	1	4	0	3	10½	0	11½	17·0
Total cost ...	£4,028	15	5	£61	0	10	£1	3	6	5	9	—

Table II shows that the yearly cost of upkeep per horse on the 11 farms amounted to £61 0s. 10d., the weekly cost £1 3s.6d., and the cost per working day 5s. 9d. Of the total cost the food bill represented 66 per cent., incidental expenses 17 per cent., depreciation 12.5 por cent., and the labour bill 4.5 per cent.

The average food consumption per horse varied considerably on the different farms, as shown in Table III.

The roots consumed would allow for a daily consumption of 12 lb. for a period of 5 months; hay for a consumption of 10½ lb. per head for 8 months; straw for a consumption of 12 lb. per head for 8 months; and the concentrated foods for a daily ration of 9½ lb. per day for the whole year, or 13 lb. per day for 8 winter months and 8 lb. per day for 4 summer months.

TABLE III.

Food Consumption per Head per Year.

	Maximum.	Minimum.	Average of 11 Farms.
Grazing	3·6 acres	0·9 acres	1·4 acres.
Roots	24 cwt.	—	10 cwt.
Hay	40 cwt.	5 cwt.	23 cwt.
Oat straw	54 cwt.	6 cwt.	27 cwt.
Oats	112 bush.	40 bush.	54 bush.
Purchased concentrated foods ...	14 cwt.	3 cwt.	11 cwt.
Total weight of concentrated foods	46 cwt.	24 cwt.	31 cwt.

If all the concentrated foods were supplied as oats, each horse would require 10 quarters per year, or the produce of 2-2½ acres. During the season 1919-1920, on the 11 farms costed, the average cost of grazing amounted to £3 6s. 0d. per acre; vetches, £13 12s. 9d. per acre; roots, £1 10s. 0d. per ton; hay, £4 15s. 0d. per ton; straw, £2 15s. 0d. per ton; and oats, £1 19s. 0d. per quarter.

Ninety-five per cent. of the roots, 85 per cent. of the hay, and 92 per cent. of the straw fed to the horses on these 11 farms were home-grown. Of the concentrated foods consumed, 62 per cent. were fed in the shape of home-grown oats.

Assuming that only home-grown foods are fed, and that these are charged at average cost of production prices, the average cost of food per horse per year would have amounted to £35 17s. 9d., or 13s. 10d. per head per week, instead of £40 5s. 5d. per head per year. or 15s. 6d. per head per week, which was found to be the actual food bill per horse.

The incidental expenses per horse on the 11 farms amounted to £10 1s. 4d. per year, or 3s. 10½d. per week, or 11½d. per working day, and constituted 17 per cent. of the total cost of upkeep. They were made up as follows :—

	£	s.	d.
Shoeing bill	4	2	6
Saddler's bill	3	8	6
Veterinary expenses		12	6
Proportionate share of rent of buildings		12	0
„ „ rates „ „		3	6
Cost of water and light		7	6
Proportionate share of insurance and other incidentals		14	10
	£10	1	4

Fortunately, farriers' charges are now coming down and 14s. will at the present time in many districts cover the cost of a new set of shoes.

On the farms in question the depreciation works out at an average of £7 9s. 5d. per horse per year, or 2s. 10½d. per week, or 8½d. per working day. The depreciation of horses varied considerably on the various farms according to the system of horse management adopted. The depreciation of a horse is the difference between its "buying-in" price when it enters the stable, and its "selling-out" price when it leaves, and every effort has been made to distribute that difference as evenly as possible over the number of years that the horse remains on the farm. Although in 1919-1920 on the 11 farms mentioned, the average cost of upkeep per horse per year amounted to £61 0s. 10d., or £1 3s. 6d. a week, and the cost of horse labour per working day amounted to 5s. 9d., the costs were found to vary considerably, namely—

(*a*) From year to year on the same farm;
(*b*) From month to month on the same farm during the same year;
(*c*) On different farms at the same time according to the management of the horse labour.

(*a*) The following table gives a summary of the yearly variations in the cost of horse labour on Farm A from 1914 to the present time:—

TABLE IV.

Year.	*Yearly cost of upkeep per horse.* £ s. d.	*Weekly cost of upkeep per horse.* £ s. d.	*No. of working days per horse per year.*	*Cost of horse labour per working day.* s. d.
1914–15	31 10 0	12 1	265	2 4
1915–16	38 15 0	14 11	258	3 0
1916–17	42 7 6	16 3	259	3 3
1917–18	52 3 4	1 0 1	248	4 2
1918–19	58 8 0	1 2 5	232	5 0
1919–20	63 4 9	1 4 4	218	5 10
1920–21	60 15 0	1 3 4	216	5 7

If the example quoted can be taken as typical of other farms, it would appear that the cost of upkeep of horses reached its maximum during the year 1919-20, and that while it is perhaps too much to hope that the average cost of upkeep will quickly fall to its pre-war level, yet we may reasonably hope that it will fall again before long to the 1917-18 or possibly 1916-17 level. Owing possibly to the shortening of the hours of manual labour under the decisions of the Wages Board, there has been a noticeable diminution in the number of working days per horse per year, and this was still further accentuated when a tractor was introduced on the farm in 1919-1920. In every case inves-

tigated by the writer, one effect of the introduction of a tractor on a farm has been without exception to increase the cost of horse labour per working day, because, owing to the fact that at certain times of the year, such as hay time and harvest, horses are absolutely essential, the introduction of a tractor is rarely accompanied by the selling off of its equivalent of horses. In consequence, there is a decrease in the number of working days per horse per year, and a corresponding increase in the cost of horse labour per working day.

(*b*) The monthly variations in the cost of horse labour will be determined mainly by the variations in the cost of feeding and in the number of days per week the horses are fully employed. More time will be usually lost in the summer than in the winter; the busy times will be hay time, harvest, and during the autumn and spring when the ground is being prepared for winter and spring corn. As already stated by Orwin,* the period of maximum unemployment for horses will usually fall between hay time and harvest.

Figures from Farm D show the monthly variations for the year 1920 in the cost of horse labour. This is a mixed farm of 205 acres, 105 of which are arable, and on which 5 working horses and one tractor are employed. During the six months January-April and November-December, the average weekly cost of upkeep amounted to £1 10s. 8d. per head, and during the six months May-October 17s. 5d. per head, or only 56 per cent. of the average winter cost. During the six winter months the horses were working, on the average, 3.6 days a week, or 66 per cent. of the number of days possible, at an average of 8s. 8d. per working day. During the summer months the horses were working, on the average, 2.8 days a week, or 51 per cent. of the number of days possible, at an average cost of 6s. 4d. per working day. The months when the horses were most fully employed were February, March and November, while August was the month of least employment. Horse labour was cheapest during May, when partly on summer rations they were working 71 per cent. of the days possible. In April, when on full winter rations, they were working only 47 per cent. of the days possible, the cost of horse labour amounted to no less than 11s. 9d. per working day.

(*c*) On the 16 farms whose accounts for the year 1920-1921 have already been completed, the cost of horse labour has been found to vary between the extreme limits of 4s. and 9s. 7d. per working day, with an average of 5s. 8d.

* Presidential address, British Association, 1921.

On Farm I, a small and well-managed farm of 86 acres, 45 of which are arable, two working horses are kept, or 4.5 horses per 100 acres of arable land. Each horse worked 255 days or 88 per cent. of the total possible. The yearly cost of upkeep per horse was £51 0s. 6d., and the average cost of horse labour was 4s. per working day. The grass-land on this farm had been limed, slagged and generally improved, and carried the equivalent of 1 horse to 1.12 acres. All the foods consumed were home-grown—good crops produced cheaply—and the total food bill amounted only to £32 5s. 6d. per head. The low cost of upkeep and the high percentage of days on which the horses were fully employed, resulted in cheap horse labour on this farm.

On Farm G the cost of horse labour per working day amounted to 9s. 7d. Here the grass-land had been badly neglected and carried the equivalent of one horse to 3.7 acres at a cost of £8 11s. 6d. The horses were well fed, each horse consuming, in addition to its grazing, 6 cwt. of roots, 35 cwt. of seeds hay, 15 cwt. of oat straw, 11 qr. of home-grown oats and 5 cwt. of purchased corn. The total food bill per horse amounted to £56 13s. 10d. The horses were bought at a high price, with a correspondingly high yearly depreciation, and the average yearly cost of upkeep per horse amounted to £89 15s. 2d. Four working horses and one tractor were kept on the farm which could not keep more than two teams busy, with the consequence that each horse was only employed on 187 days or 66 per cent. of the total possible. This resulted in dear horse labour; the farm was overstocked with horses; the grass-land was not carrying the stock it could have done under good management; and the horses were not kept fully employed and *were being heavily fed while doing little work.*

It is surprising to find how frequently the rations of farm horses fail in being adjusted to the work they are doing. On one farm where the horses were only working 1.2 days per week during July last they were receiving more than 10 lb. of oats per head per day in addition to their grazing, and with a weekly cost of upkeep of 17s. 6d. per head the horse labour was costing during that month *14s. 1d.* per working day. Every farmer realises in a general way the importance of keeping his horses busy, but not all fully realise how largely the cost of horse labour influences the costs of cultivation and the costs of production of farm crops.

On Farm I where the horses worked 255 days last year, or 88 per cent. of the total number possible, at a cost of 4s. per working day, the cost of ploughing during the whole year

averaged 17s. 6d. per acre and the horse labour added £1 0s. 6d. per acre or 4s. 3d. per qr. to the cost of growing wheat.

On Farm G where the horses worked 187 days last year, or 66 per cent. of the total possible at a cost of 9s. 7d. per working day, the cost of ploughing during the whole year averaged *£1 8s. 9d.* per acre, as compared with 17s. 6d. per acre on Farm I, and the horse labour added £2 9s. 5d. per acre or 10s. 6d. per qr. to the cost of growing wheat.

SEED CONTROL, 1920-21.

THE results of last year's administration of the Testing of Seeds Order, 1918, are interesting from many points of view. In spite of the difficulties caused by the coal strike, occurring as it did during the busiest period of the seed trade, no fewer than 632 seed establishments were visited by the Ministry's Inspectors for the first time, and a large proportion of the 3,250 firms already called upon were revisited. The principal objects of these visits were to ascertain whether sellers of seeds were complying strictly with the requirements of the Order, and to draw control samples, where necessary, for the purpose of having check tests carried out at the Official Seed Testing Station. At the same time the opportunity was taken to acquaint seedsmen and farmers with the main provisions of the Seeds Act, 1920, which was passed to regulate the sale of seeds in the interests of British agriculture.

Control Samples.—The number of control samples, apart from packets of garden seeds, taken during the 1920-21 season, was 1,757, and included 364 samples of clover, 273 of grasses, 19 of field seeds, 25 of cereals, 432 of roots and 644 of vegetables. The check tests carried out at the Official Seed Testing Station showed that in 146 cases, or about 8 per cent. of the total number of samples taken, the declaration made by the seller was inaccurate in certain particulars. These discrepancies were mainly in respect of clover, grasses and field seeds; 15.9 per cent. of the total number of clover samples, 13.2 per cent. grass samples and 15.8 per cent. field seed samples proving to be inaccurately described. During the 1919-20 season, of the total number of 1,206 samples drawn, there were 109 cases (about 9 per cent.) in which the declaration made by the seller was not confirmed by the official test. Here again, as was also found

in the 1918-19 season, the discrepancies were mainly in the clover and grass samples.

The principal sources of error in the statements made by vendors of seeds during 1920-21 are given below, together with the corresponding figures for the previous season :—

1920-21.	*Corresponding figures 1919-20.*
(a) Number of cases in which the declared percentage as to germination differed from the figures ascertained on the official test—	
between 10 per cent. and 15 per cent.—27 ...	17
,, 15 ,, ,, 20 ,, —32 ...	5
over 20 per cent.—53	14
(b) Number of cases in which the difference in purity was from—	
3 per cent. to 5 per cent.—3	15
5 per cent. to 10 per cent.—2	6
Over 10 per cent.—1	4
(c) Number of cases in which the presence of Dodder was not declared—20	20
(d) Number of cases in which the percentage of injurious weed seeds was not correctly declared—7	32
(e) Number of cases in which the declaration was incomplete—7	5
(f) Number of cases in which no declaration at all was given—25	7

It will be observed that the number of cases in which the percentage figure of germination was radically wrong has increased by over 300 per cent. as compared with last year. Of the total number of cases in which the declared percentage of germination was at variance with the results ascertained on the tests, namely, 112, 69 related to clovers and grasses, and 41 to vegetable seeds. Of the former, trefoil showed the worst results, 18 cases being recorded of which 14 showed a difference in germination of over 20 per cent. Among the vegetable seeds parsnip was the worst offender, accounting for 12 cases of which 7 showed a difference of over 20 per cent.

As experience in the administration of the Testing of Seeds Order increased with each year's working, the Inspectors were careful to draw control samples only from bulks which they had reason to think were not up to the standard declared by the vendor. It is, therefore, a difficult matter to draw general con-

clusions from the results of the official analyses of these samples. The principal factors governing the germinative value of seeds are, of course, the condition in which seed is harvested and the conditions under which it is stored. From a series of observations carried out at the Official Seed Testing Station it was found that high-grade seed stored in good condition lost little of its germinative power in 12 months. As was to be expected, however, the fall in germination of seed of inferior quality, even when well stored, was more marked. In some of the cases in which inquiries were made, as a result of the test of a control sample, it was ascertained that the original test of the seed, before it was offered for sale, was carried out at the Official Seed Testing Station, and in one or two instances it was possible to conduct a series of re-tests of portions of the original sample and of the control sample. A few typical examples are given in the table below.

	Date of test.	*Germination, per cent.*	*Date of re-test of further portions of sample.*	*Germination, per cent.*
Sample No 1 (Crested Dogstail)—				
Original sample sent to Station by wholesaler	Feb., 1921	88	July, 1921	83
Control sample taken from bulk	June, 1921	68	July, 1921	45
Sample No. 2 (American Timothy)—				
1st sample sent by wholesaler	Nov., 1920	96	July, 1921	95·3
2nd sample sent by wholesaler	Dec., 1920	94	July, 1921	95
Control sample taken from bulk stored by retailer	June, 1921	82	July, 1921	76
Sample No. 3 (Irish Italian Ryegrass)—				
Sample sent by wholesaler	Nov., 1920	89	June, 1921	86
Control sample taken from bulk	May, 1921	72	June, 1921	66

From these figures it will be seen that under the conditions of storage which exist at the Official Station, the portion of the original sample showed little loss in germination, whereas the results of the re-test of the control sample, which, it must be remembered, was taken from the bulk stored by the seller, indicated that the seed was deteriorating rapidly. While, therefore, the increase in the percentage number of cases in which the declared figure of germination was below the figure stated by the vendor may be attributed largely to the conditions pre-

vailing at last year's harvest, there is not much reason to doubt that if seedsmen gave greater consideration to the question of storage there would be fewer cases of abnormal fall in germination of seed offered for sale.

Another outstanding feature of the 1920-21 season was the increase in the number of cases reported to the Ministry in which seeds were offered for sale without the particulars as to purity, germination, etc., prescribed by the Order being stated. The majority of the vendors pleaded ignorance of the requirements of the Order, while others stated that samples of the seed were "in test." In all but a few cases, however, the results of the check tests showed that the seed offered for sale was of average quality. The omission to state the required particulars was pointed out to the offending firms, who were warned that if the circumstances were repeated the Ministry would not take so lenient a view of the matter. The fact that the number of cases reported to the Ministry under this head is more for the 1920-21 season than for the previous season cannot be regarded as an indication of a general laxity on the part of seedsmen to comply with the provisions of the Order, but is due more to increased vigilance on the part of the Ministry's Inspectors with a view to checking this form of evasion. As a general rule, the reports show that in almost all districts there was a desire to observe carefully the statutory requirements.

In almost every case where the attention of the vendor was called to the discrepancy between the particulars declared by him and those ascertained on the check tests, the action of the Ministry resulted either in the stocks of seed being destroyed, or in the seller adopting the official test as the basis of his statement in further sales.

It is satisfactory to record the great improvement in the purity of seeds, and the decline in the number of cases where the percentage of injurious weed seeds was incorrectly stated, as shown in the analyses of the control samples, especially as samples from suspected stocks only were drawn as a rule.

Points arising in the Administration of the Order.—*Prosecution.*—The only prosecution for an infringement of the provisions of the Order was heard in May, 1921, when legal proceedings were taken against a Welsh seed merchant on two informations:—

(*a*) For exposing for sale seed oats without displaying a copy of the declaration required by the Order.

(*b*) For failing to give the Official Sampler the particulars required by Clauses 1 and 2 of the Order in respect of samples taken.

On the first count the defendant was fined 20s. and 42s. costs, while the second charge was dismissed by the Court on the ground that the defendant had made a mistake in allowing a sack of feed oats to be sampled instead of seed oats.

Partial Failure of Wheat Crop.—The attention of the Ministry was drawn to the partial failure of a field of autumn-sown wheat in Devon. The failure was alleged to be due to seed of low germination, and it was ascertained that the firm from whom the farmer purchased the seed omitted to furnish the particulars required by the Order within one month of the delivery of the seed. On inquiry being made, however, it was found that a sample of the seed had been tested at the Official Seed Testing Station, and that the germination was shown to be reasonably high. The seed had been treated by the purchaser with a preparation for the prevention of smut, which was probably the cause of the partial failure of the crop.

Impurities of Red Trefolium.—A sample of red trefolium was taken on the premises of a seedsman in Devon, the purity of which was being declared as 95 per cent. On a check test being carried out, it was found that the purity was only 77 per cent., the bulk of the impurities consisting of red clover. The evidence appeared to be sufficient to support proceedings for a breach of the Order, but as apparently the adulteration occurred through careless handling in the warehouse, and not through malicious intent, it was decided to do no more than send a strongly-worded letter of warning to the seedsman in question.

Case of Low Germination.—A sample of parsnip seed taken on the premises of a firm of ironmongers was found, on an official test, to germinate only 4 per cent. It was ascertained that the seed, together with other lots, was purchased by the vendors when taking over the business 12 months previously. On the matter being taken up with the firm, the parsnip seed was destroyed, and samples of the other seeds were sent for testing.

The Sale of Seeds in Small Packets.—During the season, 1,534 packets of seeds were drawn by the Ministry's Inspectors and sent to the Official Seed Testing Station for check tests to be carried out. The results of these tests showed that 80.4 per cent. of the packets contained seed germinating at or above the standards authorised by the Testing of Seeds Order, 13.2 per cent. were below the standard but above two-thirds, and 6.4 per cent. were below two-thirds of the standard. These figures, while indicating a slight improvement on the averages for the previous seasons, show that there are still in the country con-

siderable stocks of packets containing seed of low germination. Under the Order it was not obligatory on the part of a vendor of packeted seeds to declare any particulars where the seed was sold at or above the minimum standard of germination. Consequently, although the seed may have been of high germination when delivered by the wholesaler, the explanation of the existence of large quantities of low-grade packeted seed is probably due to unsold packets being held over by retailers from one year and offered for sale the next. It frequently happens that stocks of this nature are in the hands of local tradesmen with no particular knowledge of seeds, whose experience is limited to the comparatively small amount of trade done seasonally. Under the Seeds Regulations, 1921, which have been made by the Ministry in accordance with the Seeds Act, 1920, a seller of packeted seeds must, in future, either furnish the purchaser with the full particulars required in the case of the sale of the particular kind of seed in bulk, or he may avail himself of the special provisions made for the sale of seeds in packets, in which case he must state the season in which the seeds were packeted, as well as other particulars relating to purity, germination, etc.

The New Regulations.—The Testing of Seeds Order, 1918, was revoked on 1st August, 1921, the date on which the Seeds Act, 1920, and the Seeds Regulations, 1921, came into operation. The Order was the first Regulation of any kind in Great Britain which was framed to protect the farmer from knowingly sowing seeds of low germination or contaminated with noxious weed seeds. It is, of course, an unquestioned fact that the farmer must spend, in producing a crop, far more in labour and materials than the initial cost of the seed he sows, and any measure which tends to improve the quality of seeds offered for sale must therefore be of lasting benefit to agriculture. In administering the Order, the Ministry was more concerned to convince farmers and seedsmen of the value of a system of seed testing than to become a Public Prosecutor in cases of omission to comply with its requirements. The experience gained and the lessons learnt during the operation of the Order have proved invaluable in framing the Seeds Regulations, 1921, and while the Ministry will continue to regard the Seeds Act, 1920, as primarily an educational measure for the improvement of British agriculture, it will not hesitate to put the penal provisions into operation, in the interests both of the farmer and of the seed merchant himself, where there is any clear case of neglect to observe the seed law.

A UNIQUE COW CLUB.

THE following note has been communicated by Professor D. A. Gilchrist, Armstrong College, Newcastle-upon-Tyne:—

What is probably a unique Cow Club, managed by a community of miners, is continuing its successful career. This is the North Seaton Co-operative Farming Society, members of which recently visited Cockle Park with the objects of seeing how land for pasture and meadow hay can be improved and of obtaining information on the economical feeding of dairy cows. The Cow Club, as it was originally called, was founded in 1872, the colliery village having no milk supply. The members numbered forty or fifty miners, each of whom paid £1. They started with three cows, increasing the number as the demand for milk increased. After a time the Colliery Company built a brick cow byre to stall 14 cows and let to the Club two fields amounting to 24 acres, half being grazed and the other half mown for hay. A larger byre was built about 15 years ago to accommodate 22 cows, and the stock now usually includes 20 cows, one bull, and a pony. Milk is supplied to anyone in the village, members and non-members. The late Mr. G. B. Forster, who was managing owner of the Colliery Company in 1872, took a great interest in the foundation of the Society.

In 1911 the Society sold milk at 3d. a quart; in 1920 the price was 6d.; but while in 1914 the average cost of keeping each cow was £22 11s., in 1920 it was £70. In 1920 each cow produced over 800 gallons of milk. By showing in the balance sheet a nominal valuation of each cow (in 1920 it was £27), the Society protects itself against any sudden and heavy fall in prices that might occur. There are now 165 shareholders in the Society, which revised its rules some eight years ago and pays 5 per cent. on the share capital, the balance, after providing for a reserve fund, being paid to members as dividend on their milk purchases. As much as 4s. in the £ has been paid in this way. The management of the Society has evidently been on sound and economic lines throughout, enabling it to sell milk at reasonable prices and to build up ample financial reserves. The main object of the Society is to meet efficiently the milk needs of its members, not to make large profits; it has shown how a club having this object can be managed economically and successfully, and has demonstrated that the two essentials to success are, first, close attention to business principles, and, secondly, proper management of the cows.

PRUNE-GROWING IN SOUTH-WEST BEDFORDSHIRE.

N. J. WOOD, B.A.,
Ministry of Agriculture.

THE prune-growing district in South-West Bedfordshire and in North Buckinghamshire occupies a belt of land about 14 miles long and 2 miles broad stretching from Stanbridge and Totternhoe in the east to Aylesbury and Wendover in the west. There are some 2,000 acres of fruit in the whole district, and in the smaller area in Bedfordshire and on the borders of the two counties about 500 acres are under prunes.

In the smaller area the soil is a fairly heavy clay, mixed with which is a large percentage of lime. This soil appears to suit the prune, and the need for lime is shown by the fact that in one orchard where prunes were planted on clay no success was obtained until the soil had been heavily limed, after which the trees made excellent growth. Many growers apply lime, which is conveniently obtained from the numerous lime-works near Dunstable. The under rock is almost pure limestone, which on the Dunstable Downs often comes to the surface.

Cultivation.—The prune orchards are all under grass and do not come into full bearing until the trees are about 30 years old. Most of the orchards were planted about 40 or 50 years ago, and are therefore now in their prime; it is said that the trees will continue bearing fruit until they are 100 years old. After planting no cultivation of the soil takes place; it is found that cultivation prevents fruiting, and once the tree is formed the orchards are allowed to run to grass and are used as poultry runs, or, later, as keep for cattle and pigs. Cow manure appears to be very beneficial to the trees.

In many of the smaller orchards the trees were planted unsystematically and little attention was paid to them in their early stages, so that they are now badly-shaped and weak-bearing. Where planted systematically, however, it has been found that the trees must be given plenty of room owing to their spreading habit and the size they attain. Thirty feet square is not too much if the trees are to have full advantage of light and air. The weak spreading habit of the tree often causes the branches to bend down to the ground with an abundant yield of fruit. Some growers have permanent props for the principal branches, and these undoubtedly prevent damage to the fruit.

Once the tree is formed no pruning is done except to cut out dead wood. Even this is often neglected, with the result that in many cases large main branches have had to be removed eventually, whereas a little judicious cutting a few seasons before would have prevented the spread of the diseased wood.

As a general rule, manuring is confined to the droppings of animals, but some growers apply farmyard manure or shoddy as a mulch round the trees; and as stated above a dressing of lime is often given.

Character of Tree.—The prune tree is always grown as a standard in this district and attains considerable size. The leaf is smaller than the ordinary plum leaf but larger than that of the damson. The fruit is very similar to the damson, but much larger, and a very fine " bloom " is a characteristic which distinguishes it in normal seasons. In taste it is bitter, but its keeping qualities are excellent, and for this reason a large quantity of the fruit is despatched for use in the Fleet. This appears to be one of its chief uses; another is that of making dyes for silken materials. So far as can be ascertained it is not used as a dessert fruit, but is largely used for culinary purposes, and owing to its lateness usually commands a good price.

Marketing.—A considerable quantity of the fruit goes to the markets in the great northern towns, but consignments are sent to all parts of the country. This season has been a very bad one; though the trees blossomed well, frost did a lot of damage before the fruit set, with the result that the crop has been practically a failure. A good season has not been experienced since 1918, when an average of about 6 tons to the acre was obtained: in 1919 about half this quantity was picked, but last year and this year only a few bushels have been gathered. A normal season yields 4-5 tons to the acre. The fruit is usually sent away in sieves and half-sieves, and as a general rule travels very well.

It is astonishing that this fine prune has not spread to other districts. There is a local belief that it does not grow well in Kent, but in all probability it has never had a fair trial. A certain number of suckers were sent to Wisbech and up to the present they are giving indications that they will do well, although their exploitable age has not been reached.

Pests.—The chief insect pest is the leaf-curling aphis which does very considerable damage in some years, a reduction of 20 per cent. in the crop resulting. Caterpillars of the lackey moth are sometimes troublesome, and a mite, which

causes galls upon the leaves and renders them unsightly, is sometimes found in the older orchards, but the damage done is not sufficient to result in appreciable loss of crop.

Silver Leaf has appeared in some orchards, but few trees have been killed or have had to be totally removed. The reason for this apparent resistance is probably the vigorous growth and natural hardiness of the prune; and the possible use of the prune as a stock for other plums, especially Victorias, is suggested as a method of combating the disease.

Very little spraying is done in the district, except in the best orchards. A home-made mixture containing copper sulphate and lead arsenate has proved very satisfactory. Some growers limewash their trees and occasionally spray with lime; but as a general rule, owing to the expense of the operation, the small orchards receive little or no treatment.

STORAGE OF APPLES.

In the past the smaller commercial growers in this country have paid very little attention to the necessity of storing their apple crop under the best conditions. Even the larger growers, with a few exceptions, rush their produce on the market direct from the trees, and in the first place cause a glut, to the detriment of all concerned, and in the second place compel the consumption in early autumn of varieties which would command a much higher financial return if kept until January or February.

In other cases the storage accommodation is of such a crude and unsuitable description that it accelerates rather than retards the decay of the fruit. Apple rot has been very virulent this season (1921) and apples which might have been expected to keep for several months have rotted wholesale in three weeks. No doubt the climatic conditions have been abnormal, rendering make-shift stores useless, mainly owing to the difficulty in keeping down the temperature. On the other hand, birds have been in desperation for moisture and their attacks on apples have been more severe than ever before, thus compelling growers to pick earlier than the weather conditions necessitated.

Essential Conditions.—So far as modern research has carried us, the following conditions as to storage are deemed to be essential, although there are indications that these views may have to be changed in the future:—

(1) An equable temperature is necessary. This should be not higher than 45° F. and preferably lower, provided it does not fall below 32° F. The building should be of such construction as not to be readily affected by the sun's heat or fluctuations in the external atmospheric temperature.

(2) There should be sufficient ventilation to guard against a stagnant atmosphere, but our ideas regarding this may have to be modified in the light of modern research. Suffice it to say that a building used for a combined office or similar purpose as well as an apple store is most unsuitable, owing to the fact that it is being opened constantly for purposes other than the packing or removal of fruit.

(3) The atmosphere must not be dry.

(4) Darkness is preferable at all times, save when the store has to be entered. A cellar is therefore much more suitable for storing apples than a room at the top of a dwelling-house or a loft or granary.

The most successful fruit stores in the country are those which have been built 3-4 ft. below the ground level and lined with boards, roofed with lath, and covered with a thick thatch of heather or reeds. Some have been covered completely with heather or reeds and some have double walls of wood filled between with sawdust, which is a splendid non-conductor. In other cases the whole building has been excavated into a bank.

The store should face north, if possible, and have the entrance at the north end. Some protection by trees and the configuration of the ground against the sun is an advantage on the south and south-west. The interior should have an earthen floor, and be shelved around the sides, with a central tier, and a passage right around. As a rule it is best to store late-keeping varieties at the further end of the store, so that they are as little affected by removals as possible.

A Successful Fruit Store.—The following are particulars of an admirable fruit house for a small fruit holding which is in use in the Eastbourne district.

It consists of a thatched shed with shelves running all round and a tier down the centre. A path about 2 ft. 6 in. runs around the central tier of shelves. The idea of thatching both the roof and sides is to ensure an equable and non-fluctuating temperature, this being very necessary for fruit storage. Heather is the finest thing for thatching a shed of this description and such a thatch will last 20 years.

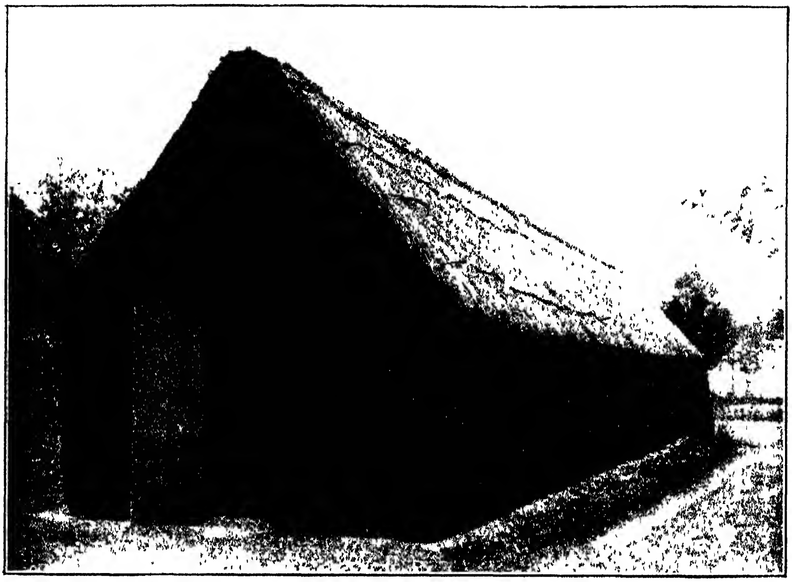
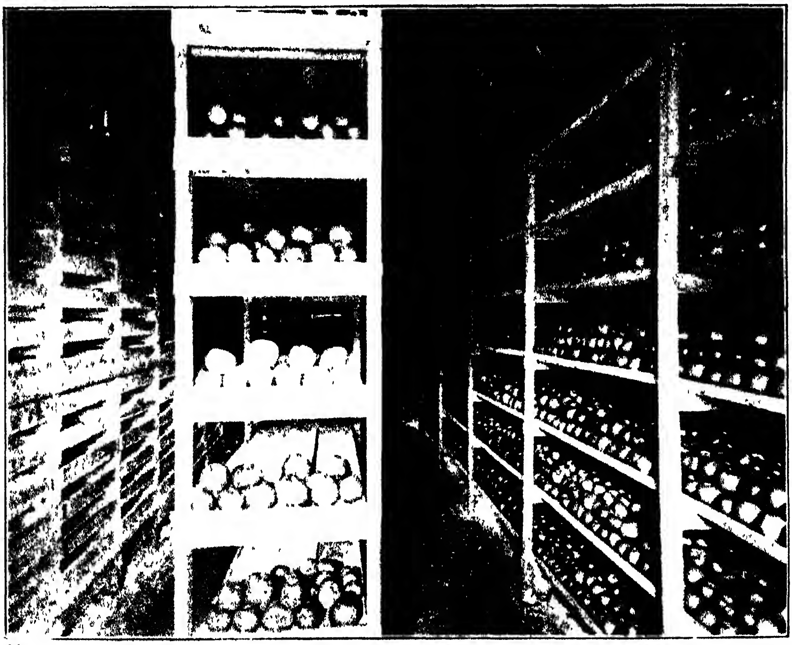


FIG. 1. A Thatched Fruit Store in use on a Small Holding.



Photos [*Reeves, Lewes.*

FIG. 2 Interior of Thatched Fruit Store, showing the arrangement of the shelves.

Again, the earthen floor is important. So many make the mistake of concreting the floor, which is bad both in hot and in cold weather. Another feature of great importance is the provision of side and end ventilation and *two* doors, the inner one being of fine gauze like a mosquito-proof door of the tropics. With the ventilator closed and the door blocked with a sheaf of straw, this store is frost-proof in the severest weather.

* * * * * *

PROGRESS IN THE REDEMPTION OF TITHE RENTCHARGE.

PRIOR to the passing of the Tithe Act, 1918, the conditions under which tithe rentcharge was redeemable were by no means attractive to landowners. The amount payable in practically all cases was 25 times the original commuted figure, so that whether the value of £100 tithe rentcharge stood at £66 10s. 9¼d., as it did in 1901, or at £109 3s. 11d., as it did in 1918, the landowner who wanted to redeem would have to pay £2,500. Moreover, where the tithe rentcharge exceeded 20s. the landowner could not redeem without the titheowner's consent, and if such a tithe rentcharge was attached to a benefice, the concurrence of the bishop of the diocese and patron of the living was also necessary.

With a view to encouraging redemption, the Tithe Act, 1918, dispensed, generally speaking, with the necessity for any consents by the titheowner, patron or the bishop, and provided that the consideration for redemption should be fixed by agreement between the landowner and the titheowner, or, in default of such agreement, by the determination of the Minister. No agreement is, however, valid :—

(a) If made by a spiritual person entitled in respect of his benefice or cure, except with the consent of Queen Anne's Bounty; or

(b) If made by a person (not being a spiritual person so entitled) who is not empowered to sell the rentcharge unless he obtains the consent of some other person, except with the consent of that other person.

Section 4 (1) of the Act directs that, in default of an agreement as to the amount of the consideration for redemption, the Minister, on the application of the owner of the rentcharge, or of the owner of the land or any part thereof, shall determine what is fair compensation for the redemption in accordance with the method prescribed in the First Schedule of the Act.

This Schedule provides that the Minister shall estimate the annual sum payable in perpetuity which he considers equal to the variable tithe rentcharge which would be payable if there were no redemption. This estimated annual sum is called the "gross annual value," and the following deductions are directed to be made from it in order to obtain what may conveniently be described as the "net annual value":—

(1) The average annual amounts paid or payable by the titheowner in respect of the rentcharge on account of rates and land tax during the three years immediately preceding the date of the application to redeem; and

(2) Such sum, not exceeding 2½ per cent. of the "gross annual value," as in the opinion of the Minister represents the necessary cost of collection of the rentcharge.

The compensation for redemption is such sum as in the opinion of the Minister is sufficient, after payment of the cost of investment, to produce, when invested in Government securities, an annuity equal to the "net annual value."

In the case of an application for redemption made on or before the 1st January, 1921, the Schedule directs that the "gross annual value" of the rentcharge must be taken to be the original commuted amount thereof, and that the compensation must be twenty-one times the "net annual value" obtained from it as explained above.

At the end of the year, on the recommendation of a Departmental Committee consisting of Sir Charles Longmore, K.C.B. (Chairman), Sir Henry Rew, K.C.B., and Mr. W. R. Le Fanu, with Mr. P. W. Millard of the Ministry as Secretary, the Minister decided that, for the purpose of any redemption of tithe rentcharge for which application was made after the 1st January, 1921, until further notice, the gross annual value for the purposes of the Tithe Act, 1918, should be at the rate of £118 for each £100 of tithe rentcharge (commuted value) and the compensation for redemption should be seventeen times the "gross annual value" after the above-mentioned deductions therefrom had been made. The following is a typical calculation of the consideration money for the redemption on these terms of £100 tithe rentcharge. Assuming that:—

(1) The rateable values of £100 tithe rentcharge (par value) for the past three years were £73, £68 and £63, and that the rates in the pound were 5s., 7s., and 9s. respectively:

(2) The assessable values for the past three years for land tax purposes were £73, £68 and £63, respectively,

and that the land tax was at the rate of 8d. in the pound in each of the three years;

(3) The cost of collection was $2\frac{1}{2}$ per cent.;

(4) The case is one in which no remission or abatement in respect of rates was allowed to the titheowner;

the consideration money for redemption would be arrived at as follows:—

		£	s.	d.	£	s.	d.
Gross Annual Value...					118	0	0
Deductions:—							
Rates on £73 at 5s. in the £ ...	=	18	5	0			
,, £68 ,, 7s. in the £ ...	=	23	16	0			
,, £63 ,, 9s. in the £ ...	=	28	7	0			
Average for 3 years, 1918-20 ...	=	23	9	4			
Land tax at 8d. in £; Average for 3 years, 1918-20, on £73, £68 and £63 respectively	=	0	17	0			
Cost of Collection, $2\frac{1}{2}$% on £118...	=	2	19	0			
					27	5	4
Net Annual Value ...	=				£90	14	8

The consideration money = £90 14s. 8d. × 17 = £1,542 9s. 4d., *i.e.*, approximately 15.42 years' purchase of the par value of the tithe rentcharge, and 14.12 years' purchase of its present value, viz., £109 3s. 11d.

It should be clearly understood that, owing to the wide variation in the relative amounts of local rates, land tax and cost of collection payable in respect of tithe rentcharge in different parishes and by different titheowners, the cost of redemption in any particular case may differ somewhat considerably from that shown in the above example. For instance, in the case of tithe rentcharge attached to a benefice, certain abatements in respect of rates are allowed to the titheowner. Consequently, in such a case, the deductions for rates would usually be less, and the amount of the consideration for redemption would be greater than in cases where the tithe rentcharge is owned by the Ecclesiastical Commissioners, a College or some other lay body or person. In cases completed on this year's basis for redemption, the calculation has worked out on an average at $17\frac{3}{4}$ years' purchase of the *par* value for tithe rentcharge attached to benefices, and $15\frac{1}{8}$ years' purchase for lay tithe rentcharge.

The Annual Report of Proceedings under the Tithe, &c., Acts, for the year 1920, recently issued by the Ministry,* states that the amount of tithe rentcharge included in compulsory applications in 1920 was approximately twice as much as in 1919 and four times as much as in 1918, and that the increase in the amount comprised in voluntary applications was much more noticeable, being nearly thirteen times the amount for 1919 and over 261 times the amount for 1918. It is also stated that the amount of tithe rentcharge included in voluntary applications received in 1920, rose from £2,396 in January to £151,243 in December, the amount for the latter month alone being double the total sum included in applications from the year 1846, when statutory provision was first made for the redemption of tithe rentcharge, up to the passing of the Tithe Act, 1918.

The number of letters received by the Ministry in 1920 in connection with business under the Tithe Acts, was approximately 65,000, while the letters sent out numbered 90,000. The number of orders, certificates, appointments of trustees and other formal instruments issued under the seal of the Minister in connection with this work, was about 15,600. The fees and charges paid to the Ministry during the year in connection with the work under the Tithe Acts were £14,818.

NOTES ON MANURES FOR DECEMBER.

E. J. RUSSELL, D.Sc., F.R.S.,
Director, Rothamsted Experimental Station.

Slag Phosphate.—A correspondent has raised the question as to what these words mean. They have been used in two senses. It has been not uncommon for agricultural experts and lecturers in speaking of basic slag to call the phosphate present therein "slag phosphate," to distinguish it from superphosphate; no doubt this use of the word will still continue owing to the difficulty of changing a common usage. During recent months, however, the words have been used to denote a mixture of basic slag and mineral phosphate which is now on the market. Farmers and others using the words "slag phosphate" must be careful to realise exactly in which of these two meanings they are intended.

* Obtainable from H.M. Stationery Office, Kingsway, London, W.C. 2, price 9d. net.

Use of Superphosphate and Basic Slag on Arable Land.—A correspondent has asked for an opinion on the following manurial scheme:—

	Super. per acre. cwt.		*Super. per acre.* cwt.
Mangolds ...	... 8 to 10	Swedes... ...	6 to 8
Wheat ...	... none	Barley and seeds	3 to 4
Oats ...	... none	Two to three years leys ...	none

The rainfall is 40 in., the climate mild, the soil on the light side and the locality in the west country.

Superphosphate has so great a value as a fertiliser that it is a pity to use it for unsuitable purposes, as prejudice may thereby be created against it. There may be some sufficient reason for the dressing given to the mangolds, but so far as one can see it is probably unnecessary to give so much; in general 2 to 4 cwt. of superphosphate per acre is sufficient; indeed at Rothamsted the entire omission of superphosphate has not depressed the crop. There are a few special cases where larger dressings have been proved to be beneficial, and in the fen districts as much as 6 cwt. gave good results. The need for high dressings of superphosphate would seem to arise only when the plant has difficulty in starting or when very heavy dressings of dung are applied, *e.g.*, the 60 or 70 loads formerly used by some of the dairymen near London. In other cases the manuring for mangolds should rather be on the basis of:—

Up to 20 loads of dung.

1 cwt. nitrate of soda or sulphate of ammonia, 2 to 4 cwt. superphosphate or basic slag, 4 cwt. French or German kainit or 1 cwt. sulphate or muriate of potash, 2 to 4 cwt. salt in the drills.

1½ cwt. nitrate of soda as a top dressing when the plants are hoed and singled.

Naturally this recommendation must be modified to suit local soil and climatic conditions.

The swedes could quite well receive slag in place of superphosphate. This has not infrequently proved a useful substitute, and wherever finger-and-toe is prevalent slag should be preferred. In some centres, however, *e.g.*, at Newton Rigg and in the Devon experiments, superphosphate came out better, except where the soil was deficient in lime.

Barley following roots that have been folded can nearly always receive superphosphate with advantage; the straw is

strengthened and the quality of the grain improved. Leys will generally do better with slag than with other phosphates.

Lime and its various Forms.—Much confusion exists as to the forms in which lime is offered to the farmer. Among the various terms used are: lime, quicklime, ground lime, burnt lime, agricultural lime, limestone, pulverised or ground limestone, chalk, hydrate of lime, hydrated lime, etc. All of these serve as sources of lime, and under proper conditions all of them could equally be used for treatment of sour soil, whether of grass or of arable land. They differ very much, however, in the amount of true lime they contain; one product may be practically all pure lime, and another, even when free from any admixture or impurity, natural or artificial, contains at the best only 56 per cent. of pure lime. It is imperative that the farmer should know exactly what he is buying. All the various substances fall into 3 groups:—

Pure lime or calcium oxide,
Carbonate of lime, or calcium carbonate,
Hydrate of lime, or calcium hydroxide.

All consignments purchased at more than a few shillings per ton should be analysed and the results stated in terms of calcium oxide (CaO) which is a perfectly clear and unambiguous term, denoting pure lime. The following shows the relationships between them:—

1 cwt. (112 lb.) of calcium oxide (CaO) has same agricultural value as 1 cwt. 36 lb. of calcium hydroxide ($Ca(OH)_2$) or 1 cwt. 88 lb. of calcium carbonate ($CaCO_3$);

or, put in reverse order and in another way:—

100 lb. of calcium carbonate has the same agricultural value as 74 lb. of calcium hydroxide or 56 lb. of calcium oxide.

On this basis it should not prove difficult to compare quotations. The materials in common use are as follows:—

Calcium oxide (CaO): Burnt lime, ground lime, lump lime, cob lime. The composition varies according to the rock from which these are produced, but a good sample may contain about 85 per cent. calcium oxide (CaO), though higher figures are also obtained.

Calcium hydroxide or calcium hydrate ($Ca(OH)_2$): Hydrated lime, hydrate of lime. Composition depends on quality and nature of the rock. We have seen a sample made from the Somerset limestone which contained 96.6 per cent. of calcium hydrate, which as shown above has the same value as 73 per cent. of calcium oxide (CaO).

Calcium carbonate ($CaCO_3$): Limestone, ground limestone, chalk, ground shells, lime mud, chance mud, and other lime wastes from factories. Some of the English limestones are very pure, running up to 90 or even 95 per cent. of purity, 100 lb. having the same value as 50-53 lb. of calcium oxide (CaO). Fineness of grinding is an important consideration here. The waste limes naturally vary considerably.

Potassic Fertilisers and Crop Yields.—During the War farmers had to do without much potassic fertiliser and many of them suffered less than they expected. The idea arose in some cases that perhaps potassic fertilisers are not as necessary as had been thought. This, however, is not a correct deduction. The withholding of potash does not usually show immediately on the crop; it produces its effects later. The number of lb. of potash (K_2O) removed from an acre of ground are as follows:—

		K_2O removed (lb.).			
	Yield per acre.	*In grain.*	*In straw.*	*Total.*	Equivalent to sulphate of potash—lb. per acre.
Wheat	36 bush.	12	24	36	67
Barley	40 ,,	10	26	36	67
Oats	50 ,,	10	42	52	96
Clover hay	2 tons			84	155
Swedes	14 ,,	Roots only		64	119
Mangolds	30 ,,	,,	,,	300	555
Potatoes	12 ,,	Tubers only		153	283

Assuming that land is in fair condition to begin with a farmer might go through a war rotation without much risk, but if after that he has taken a potato crop he has probably fairly heavily depleted the store of potash in the soil. Lack of potash shows itself in a variety of ways, but when liberal nitrogenous manuring is given a common indication is a tendency to disease. Most good farmers are supplying nitrogenous fertiliser more liberally than they used to do. Before the War the total consumption in the United Kingdom of sulphate of ammonia and nitrate of soda used to be 140,000 tons per annum; in 1920 it was 237,000 tons. If farmers simultaneously reduce the consumption of potassic fertilisers they run the risk of inducing undesirable effects such as lack of vigour in their crops. This point has been definitely tested with a glasshouse crop. Dr. W. F. Bewley showed at the Cheshunt Experimental Station that the number of tomato plants affected by the "stripe disease" was, out of a total of 120 in each plot:—

Variety.	*Complete fertiliser.*	*No potassic fertiliser.*
Comet	40	78
Kondine Red.	13	33

Cases have this year been brought to the writer's notice of crops unexpectedly doing less well than might have been expected in spite of the drought; *e.g.* of corn after potatoes, of mangolds after mangolds, and the fact that the first-named crop in each case is a potash depleter suggests that a remedy might be in the use of potassic fertilisers.

NOTES ON FEEDING STUFFS FOR DECEMBER.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Ministry of Agriculture and Fisheries.

Feeding Wheat to Stock.—Several correspondents have written to ask that, in view of the fall in price, wheat should be included in the list of feeding stuffs dealt with in the following table. It has therefore been included, and it will be seen that the price has reached a stage where it is as economical to the farmer to feed the wheat to stock as to market it for flour. It is also interesting to note that at the prices recorded in the table, both bran and middlings are more expensive to feed than wheat itself. The points to be observed in feeding wheat are familiar to most stock feeders, but it will perhaps do no harm to repeat them. (1) Wheat should be ground for all stock except sheep, since the kernels are small and hard. (2) Wheat so ground should be ground only to a very coarse meal. If ground to a fine meal, the meal pastes in the mouth and forms an unsatisfactory feeding stuff. (3) Wheat should only form a small proportion of the concentrates fed to stock, except perhaps in the case of the pig. With the horse, feeding wheat in any quantity leads to digestive disturbances and skin eruptions.

Farm Values of Feeding Stuffs.—It is very convenient for the farmer to obtain some idea of the value per ton of the home-grown feeding stuffs as compared with purchased feeding stuffs, and several correspondents have asked that hay and oat straw should be included. An attempt has been made to do this, taking for comparison in the case of hay and straw, dried grains, and in the case of oat and vetch silage, the average

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	49/-	504	10 18	1 17	9 1	71·6	2/6	1·34
Barley, English Feeding	36/3	400	10 3	1 6	8 17	71	2/6	1·34
„ Canadian „	33/6	400	9 8	1 6	8 2	71	2/3	1·20
Oats, English White „	29/6	336	9 17	1 9	8 8	59·5	2/10	1·52
„ „ Black & Grey	27/-	336	9 0	1 9	7 11	59·5	2/6	1·34
„ Argentine	27/6	320	9 12	1 9	8 3	59·5	2/9	1·47
Maize, „	31/6	480	7 7	1 5	6 2	81	1/6	0·80
Rye, English	40/-	504	8 18	1 8	7 10	72	2/1	1·12
Millers' offals—Bran	—	—	8 5	2 10	5 15	45	2/7	1·38
„ „ Coarse middlings	—	—	11 5	2 10	8 15	64	2/9	1·47
Barley meal	—	—	14 0	1 6	12 14	71	3/7	1·92
Maize „	—	—	8 10	1 5	7 5	81	1/9	0·94
Fish „	—	—	16 10	7 12	8 18	53	3/4	1·78
Linseed	—	—	17 10	2 16	14 14	119	2/6	1·34
„ Cake, English (9°/₀ oil)	—	—	12 12	3 12	9 0	74	2/5	1·29
Cotton seed „ English (5°/₀ oil)	—	—	8 15	3 5	5 10	42	2/7	1·38
„ „ Egyptian (5°/₀ oil)	—	—	8 10	3 5	5 5	42	2/6	1·34
„ „ decorticated (7°/₀ oil)	—	—	14 0*	5 6	8 14	71	2/5	1·29
Coconut cake (7°/₀ oil)	—	—	10 15	3 0	7 15	79	1/11	1·03
Palm kernel cake (6°/₀ oil)	—	—	7 10	2 1	5 9	75	1/5	0·76
Brewers' grains, dried, ale	—	—	10 0	2 7	7 13	49	3/1	1·65
„ „ „ porter	—	—	9 0	2 7	6 13	49	2/9	1·47
„ „ wet, ale	—	—	2 5	0 12	1 13	15	2/2	1·16
„ „ wet, porter	—	—	2 0	0 12	1 8	15	1/10	0·98
Malt culms	—	—	7 0	3 6	3 14	43	1/9	0·94
Potatoes †	—	—	1 15	0 8	1 7	18	1/6	0·80
Swedes †	—	—	0 15	0 5	0 10	7	1/6	0·80
Mangolds †	—	—	0 15	0 6	0 9	6	1/6	0·80
Vetch and Oat Silage †	—	—	2 6	0 15	1 11	14	2/3	0·80
Good Meadow Hay †	—	—	6 10	1 14	4 16	31	3/1	1·65
Oat Straw †	—	—	2 19	0 17	2 2	17	2/6	1·34
Good Clover Hay †	—	—	7 1	2 2	4 19	32	3/1	1·65

* Price at Liverpool. † Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of October and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

of a fibrous food such as dried grains and a starchy food such as maize. It is desired to emphasise here that scientific accuracy is not aimed at in this assessment of values, but it is felt that the figures given per ton give the farmer a rough approximation of the value of his home-grown products. The figure is used in this way. As shown in the table, with maize at £7 7s. per ton, the farm value of potatoes is £1 15s. If, therefore, a farmer has potatoes which he can market at, say, £4 per ton, and the transport and marketing costs of selling the potatoes per ton and of delivering the maize to the farmer come to less than £2 5s., it clearly pays him to sell his potatoes and buy in maize at £7 7s. per ton for feeding. Similarly, with brewers' grains at £10 per ton, the farm value of good clover hay is £7 1s. per ton. It will therefore not pay a farmer to sell clover hay and buy in dried brewers' grains, unless the price realised at market, deducting marketing expenses and cost of delivery of the brewers' grains, comes to more than £7 1s. per ton of clover hay sold.

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CONCILIATION COMMITTEES IN AGRICULTURE.*

THE whole of England and Wales is now covered by Conciliation Committees which have been set up under the Corn Production Acts (Repeal) Act, 1921, to deal with questions of wages and hours and conditions of employment of workers in agriculture. In certain cases the representatives of local employers and workers have arranged the formation of separate Committees for parts of the areas formerly covered by single District Wages Committees, with the result that there are now 56 Conciliation Committees as compared with the 39 District Wages Committees under the Wages Board system.

In four areas the Conciliation Committees have submitted their recommendations to the Minister for confirmation and the necessary steps have been taken, in accordance with the power vested in the Minister under the Act, to confirm the Committees' agreements. The details of the agreements so confirmed are as follows:—

(1) *Cambridgeshire.*—A wage rate of 37s. 6d. for a week of 50 hours (excluding Sunday) shall be paid during the period from 22nd October to the 2nd December, 1921, for all able-bodied men of 21 years of age and over.

* This note explains the position as it existed on 21st November, 1921.

(2) *Surrey.*—(*a*) A wage rate for carters, cowmen and shepherds between the ages of 21 and 65 of 47s. 6d. for a maximum week of 60 hours (including Sunday) and a less weekly rate at the same rate per hour for a maximum week of less than 60 hours; all time in excess of 60 hours per week (including Sunday) to be paid at the rate of time and a quarter after the 60 hours have been worked.

(*b*) A rate for all male workers employed in agriculture between the ages of 21 and 65, other than those specified in clause (*a*) above, of 38s. per week of 48 hours (excluding Sunday); all time in excess of 48 hours per week (excluding Sunday) to be paid for at the rate of 11d. per hour, and all employment on a Sunday to be payable at the rate of 1s. per hour.

(*c*) All the rates specified to apply only to workers whose employment is terminable by a week or longer notice, and to operate from the 1st November to the 31st January, 1922.

(3) *Denbigh and Flint.*—During the period from 19th November to the 31st December, 1921, the wages payable to all male workers of 21 years of age and over employed in agriculture shall be not less than 37s. 6d. for a week of 50 hours (excluding Sunday); all time in excess of 50 hours per week (excluding Sunday) to be paid for at the rate of 10d. per hour, and all employment on a Sunday to be payable at the rate of 1s. per hour.

(4) *Isle of Ely.*—During the period from the 12th November to the 14th January, 1922, no male worker employed in agriculture shall be paid wages at less than the following rates:—

(*a*) *Male Workers aged 18 and over employed as Horsemen or Milkmen.*

Years of age.		
21 and over	45s. 6d.	For a week comprising the hours necessary for the performance of the customary duties of these classes of workers.
20 and under 21	42s. 6d.	
19 " " 20	40s. 0d.	
18 " " 19	38s. 6d.	

(*b*) *All other male workers employed in agriculture.*

Ages.	*Weekly Wages for a week of 48 hours.*	*Overtime rates for all time in excess of 48 hours per week.*
21 and over	36s. 0d. ...	10d.
20 and under 21	33s. 6d. ...	9½d.
19 " " 20	31s. 6d. ...	9d.
18 " " 19	30s. 0d. ...	8½d.
17 " " 18	24s. 0d. ...	6½d.
16 " " 17	19s. 0d. ...	5½d.
15 " " 16	15s. 6d. ...	5d.
14 " " 15	12s. 0d. ...	3½d.
Under 14	8s. 6d. ...	2½d.

While no definite agreement is made regarding Saturday half-day, the employers will not put any obstacles in the way of farmers arranging with their workmen for a Saturday half-day after 48 hours have been worked and this Clause is to be carried out in a reasonable spirit.

It should be borne in mind that these rates have been confirmed on the application of the Committees for the areas concerned. For the period of the operation of a confirmed agreement the rates specified in the agreement form an implied term of the contract of employment of every worker of the class in the particular area to which the agreement applies.

Agreements have also been reached by the Conciliation Committees in 30 additional areas, but the Committees in these cases have not made application to the Minister for confirmation of the agreements. In 7 of these areas the agreements having been made for a comparatively short period have already lapsed. Particulars of the current agreements relating to adult male workers in the remaining 23 areas are given below :—

Area.	*Period.*	*Wages.*	*Hours per week.*
1. Cheshire	Up to 31st Dec. ...	40/6	54
2. Cornwall	„ 31st „ ...	42/-	52
3. Cumberland and Westmorland ...	„ 2nd Feb., 1922	37/6 50/-*	48 63
4. Devon	„ 3rd Dec. ...	36/-	50
5. Dorset	„ 31st „ ...	36/-	48 With Saturday half-holiday.
6. Durham	„ 1st Mar., 1922	44/6	50
7. Hertfordshire ...	„ 31st Dec. ...	38/- 41/-	48 52
8. Kent	„ 31st „ ...	38/-	50
9. Leicestershire ... Bosworth and Ashby	„ 31st „ ...	38/-	50
10. Market Harborough and Lutterworth ...	„ 31st „ ...	36/-	50
11. Norfolk	„ 31st „ ...	36/-†	48
12. Northants	„ 31st „ ...	36/6	48
13. Oxford	„ 31st „ ...	36/-	48
14. Shropshire	„ 31st „ ...	9½d. per hour up to 60 hours with guaranteed week of 48 hours.	
15. Soke of Peterborough	„ 30th Nov. ...	37/- 42/- †Cottage 44/- †Cottage	48 Not defined ‡
16. Somerset	„ 25th „ ...	38/-	50
	From 25th Nov. to 31st Dec.... ...	36/-	50
17. Staffordshire ...	Up to 29th Jan., 1922	9½d. per hour for a minimum week of 50 hours.	
18. Warwick	Up to 1st Dec. and until further notice	36/-	48
19. Worcester	Up to 1st Mar., 1922	36/-	48
20. Yorkshire ... (East Riding) ...	„ 26th Nov. ...	39/-	7 a.m. to 5 p.m. each weekday with Saturday half-holiday

21. Yorkshire ... ... (North Riding)	Up to 30th Nov. ...	40/-	50
22. Brecon and Radnor...	„ 30th „ ...	38/-	50
23. Carnarvon	„ 5th Mar., 1922	35/-	48
		38/-§	60
	From 6th Mar. to 13th May, 1922	35/-	50
		38/-§	61

* These rates refer to "skilled" workers.

† Additional 7/- per week for workers employed wholly or mainly as teamsmen, cowmen or shepherds. Additional 5/- per week for workers employed wholly or mainly as sheep-tenders or bullock-tenders.

‡ These rates refer to horse-keepers and stock-keepers respectively.

§ These rates refer to special classes workers.

Although there are several areas in which the Conciliation Committees have not yet settled the wages question, further meetings are taking place daily and it is anticipated that these Committees will before very long find means to solve their local difficulties and reach a basis of agreement as to appropriate rates of wages.

Land Drainage as a Means of Alleviating Unemployment.

THE Ministry desires to announce that a sum of money has been placed at its disposal for carrying out land drainage schemes primarily for the alleviation of unemployment.

The bodies to whom advances will be made for this purpose are (*a*) Drainage Authorities, and (*b*) County Agricultural Committees. Those mentioned in the second category are intended only to deal with those portions of the country where no Drainage Authority has been set up. The scheme is shortly described below.

The Ministry will, if its technical officers are in a position to approve the schemes submitted, be prepared to advance all the money required in each case, subject to the following conditions:—

(*a*) That all work shall be done as much as possible by hand labour.

(*b*) That 75 per cent. of the labour shall be ex-service men, if available.

(*c*) That, of the remaining 25 per cent., the majority shall be married civilians, if available.

(*d*) That the wages payable for ordinary labour shall not exceed the Agricultural rates for the district as fixed by Conciliation Committees or otherwise, and

(*e*) That at least 35 per cent. of the money advanced will be refunded to the Ministry.

The Ministry, in addition, reserves the right to inspect the works from time to time, to supervise the operations generally, and to call for progress reports when required.

The main object to be achieved is to get men rapidly on to suitable work, and the Ministry does not intend therefore to let any unnecessary formalities stand in the way of schemes that can be put in operation promptly.

It is hoped that all the Authorities concerned will co-operate cordially in making the above proposals a success and in getting as many men at work as possible, and thus at the same time improving the drainage of the country, on as large a scale as possible.

There is much land in England and Wales which suffers from permanent water-logging, or too frequent flooding, and the above proposals will, it is hoped, result in much additional land being brought into a more productive state than it is in at present.

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Horticultural Advisory Council.

HORTICULTURISTS and fruit-growers will notice with satisfaction that a new Horticultural Council has been established on a representative basis to advise the Ministry on all questions connected with the promotion of market-gardening, fruit-growing, flower-growing, and horticulture generally, including bee-keeping. In particular it is the function of the new Council to advise regarding the proper distribution of produce and the organisation of allied trades. It consists of about 40 members, one-fourth of whom are either representatives, or nominees, of the Ministry. The remaining members are nominated by various Associations, among which and representing the growers are the National Farmers Union, the Federation of British Growers, the Horticultural Trades Association, the National Union of Allotment Holders, the Royal Horticultural Society, and the Lee Valley Growers Association. The present nominees of these bodies include such well-known authorities as Mr. R. R. Robbins, C.B.E., Mr. F. Glenny, Mr. W. P. Seabrook, Mr. E. A. Bunyard, Mr. A. G. Jackman and Mr. F. J. Chittenden. Labour in Horticulture is represented by nominees of the Workers' Union and the National Union of Agricultural Workers, respectively. The wholesale Trade is represented by nominees of the National Federation of Fruit and Potato Trades' Association, and these include Major E. G. Monro and Mr. Geo. Swift. The Retail

Trade is represented by nominees of the National Federation of Retail Fruiterers, etc., Ltd., and these include Mr. M. Cowley and Mr. E. L. Vinden. The Fruiterers Company is represented by Mr. F. R. Ridley, and the Fruit Preserve Manufacturers, the Cider Industry and the Florists, are also represented, whilst the Chamber of Horticulture sends three representatives, including Mr. J. Rochford and Mr. C. E. Pearson. The Secretary of the Council is Mr. J. L. Bryan, M.B.E., of the Ministry of Agriculture and Fisheries, to whom all communications relating to the business of the Council should be addressed.

The Minister of Agriculture and Fisheries, in establishing the new Council and opening its first meeting recently, wished it every success and drew attention to several matters of importance to which it could usefully direct its attention.

Potato Growing: Demonstration Plots, 1922.

IN view of the importance of the potato crop and the need which still exists in most parts of the country for more information on all matters pertaining to potato culture, the Ministry considers that it is very desirable that the scheme of potato trial plots which has been carried out during the past two years by County Education Authorities should be continued in 1922. In previous years the main objects of the trials have been to demonstrate the cropping qualities of the newer varieties of potatoes immune to Wart Disease, and to prove the value of an adequate system of manuring. The trials for 1922 also have these two objects, and further, are intended to demonstrate the value of planting good seed from which all diseased and weakly tubers have been removed.

The varieties chosen for demonstration are:—*First earlies*: Immune Ashleaf and Dargill Early. *Second earlies*: Ally, Great Scot and Arran Comrade. *Maincrop*: Kerr's Pink, Majestic, Tinwald Perfection, Bishop, Irish Chieftain and Rhoderick Dhu.

Supply of Seed.—In order to demonstrate to the public the advantages to be gained by the use of reliable, healthy and immature seed, the Ministry made arrangements in the 1921 season, whereby special crops of the above varieties were grown in the same locality in East Ross-shire—a district far north, free from Wart Disease, where potato blight is seldom severe, and leaf curl is rarely known. Whilst growing, the crops were "rogued" and all weakly plants and those affected with leaf

curl or mosaic were removed under the supervision of one of the Ministry's experts. It is believed that the resulting seed is pure and healthy.

In cases where seed potatoes have been saved from the Ministry's trials in 1921, it is suggested that some be planted in 1922, so that trials can be made in order to compare the cropping qualities of this "once grown" English seed with those of seed of the same varieties direct from Scotland. The conditions under which both trials are made should, so far as possible, be uniform. If seed is saved from both crops in 1922, it should be possible in 1923 to carry the comparison still further and to compare the cropping qualities of Scottish seed with those of English "once grown" and English "twice grown" seed.

Quantity of Seed.—It appears generally convenient in these trials to use 28 lb. of each variety, and Authorities are asked not to make any alteration except for some special reason.

Manures.—The manurial treatment recommended for potatoes is that the land should receive a dressing of farmyard manure at the rate of about 15 tons per acre, applied in autumn, or, in the Northern districts, in the drills at the time of planting. Artificial manures should also be applied on dates to be recorded, in quantities somewhat as follows:—

Superphosphate (30 per cent.)	4 cwt. per acre.
Sulphate of Ammonia	1 " " "
Sulphate of Potash (50 per cent. Potash) ...	1 " " "

It is hoped that the trials will be carried out on uniform lines, since any deviation in manuring would somewhat influence the results; Authorities are therefore asked to adhere as closely as possible to the conditions set out.

Planting.—The time of planting will vary slightly according to the district, the usual time of planting in the district being adopted. It is further suggested that a distance of 30 in. between the drills, and 12 in. between the sets, should be maintained throughout all the trials. Any departure from these distances should be noted in the records of the trials.

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Superphosphate: Plentiful Supplies Available.

DURING the early part of the autumn of 1920, the demands for phosphate for agricultural purposes appeared to be far in excess of the supply, and there was a prospect that this serious shortage would continue. The position, however, rapidly changed in January, February and March, 1921, and during the spring large quantities of phosphate con-

tinued to arrive. At the present time there is no question that all the superphosphate required for agriculture for the autumn and spring seasons of 1921-22 will be forthcoming, and at very much lower prices than have been possible hitherto.

Superphosphate is now on sale throughout the United Kingdom at about 3s. 3d. per unit of water soluble phosphate, a price which is based on the current cost of importing the raw materials required for its manufacture. In making this important reduction in price, the manufacturers are bearing a heavy loss on the large stocks of raw materials which were imported prior to the recent fall in freight rates, and are still held by them.

It is well known that superphosphates as such, and as contained in compound fertilisers, stand alone in providing a form of "water soluble" phosphate which confers certain special benefits on the young crop, unobtainable from phosphates in any other form. Water soluble phosphate dissolves in the first rain, percolating through the soil and becomes precipitated in extremely fine particles where the earliest roots of the crop are or will be penetrating. In this condition it has a most valuable stimulating effect on root development, especially for shallow-rooted crops like swedes, turnips and kindred fallow crops, and barley, and it has been the experience of farmers that nothing assists the establishment of a crop so much as a small amount of superphosphate with or near the seed. Superphosphate is thus particularly associated with arable farming.

It should not be assumed that the water soluble content of superphosphate and of compound fertiliser, forms the total phosphate which the materials contain. In the case of superphosphate, 30 per cent. water soluble, there is in addition about 2 per cent. other phosphates that are not counted in reckoning the price per unit, which is based only on the water soluble phosphate. With compound fertilisers, the total phosphate content is brought into account, the water soluble content being charged at about 4s. per unit, citric soluble phosphate at 3s. per unit, and insoluble phosphate (so-called) at 2s. per unit.

The Marketing of Poultry and Eggs.

RECENT inquiries made by the Ministry in the markets of London, Birmingham and various provincial towns show that the methods generally adopted in the marketing of poultry and eggs are very unsatisfactory. The reason appears to be the absence of proper organisation and of correct marketing

methods on the part of many amateurs engaged in poultry production. Salesmen complain of irregular supplies, and although this is natural enough in some respects owing to variations in seasonal production, the fact remains that there is often a glut in one market and a shortage in another through the lack of organisation and co-operation on the part of the producers. Complaints are frequently heard of carelessness, and even of sharp practice, in the marketing of eggs and poultry, and it is not surprising that English eggs in particular have sometimes a poor reputation on English wholesale markets. The Ministry considers that the position can be remedied to a large degree.

With regard to poultry, those producers of table poultry who regard this branch of work as of secondary consideration to the production of laying pullets, should not be dilatory in marketing their surplus cockerels. If no attention is paid to these birds they may be in poor condition when they are marketed. A few weeks lost in the earlier part of the table poultry season when supplies are scarce, mean that the best market has been missed, that the birds may arrive in inferior condition because they have been poorly fed, and at a time when there is a glut of poultry. In consequence the financial returns suffer to a treble extent. The farmer is often the worst offender in this direction. It often happens that he does not market the birds until they are comparatively old and tough. The salesmen are sometimes blamed for this, but it is clearly not their fault. It may happen in some cases that in consequence of a glut during hot weather, some of the dead poultry may become unfit for food and therefore unsaleable.

The producer of English table poultry should always bear in mind the competition with the improving classes of imported poultry. Even though he may be producing only second-grade poultry, properly marketed they will successfully compete with the best imported produce. At the present time it is not uncommon to find buyers showing a preference for imported produce over good English poultry on the wholesale market, the reason being that the imported birds are known to be of a reliable and uniform quality. The English producer should therefore breed birds of a type which will fatten economically and produce the kind of flesh the market requires. If marketed dead the birds should be prepared in such a way as to ensure their reaching the market in the freshest condition and in the way which is most acceptable to buyers.

With regard to eggs, gluts on the market are not avoidable, though they can be mitigated by the producer arranging that his hens come into lay at the time of year when eggs are scarcest. Eggs frequently give indifferent returns because they are not properly graded and packed, and the buyer is not satisfied that they are of reliable quality. Carelessness in collecting and storing, delay in marketing, and the holding back of eggs in prospect of a rise in price, are among the reasons why eggs of doubtful quality are sent to the salesmen. Clearly, the buyer cannot risk his reputation by passing them on as eggs of a reliable standard. He requires regular consignments of first-grade eggs, to which he can apply an accurate label of high quality. The competition from imported eggs is much greater than in the case of poultry, and it is actually the position now that eggs from the Continent are at present more reliable for sale as new-laid than some consignments of English eggs. This can be remedied by prompt and business-like methods on the part of our producers, and the marketing of their eggs through co-operative societies which will attend to regular collecting, proper grading, packing and marketing.

Egg and Chick Distribution Scheme.

THE Ministry recently issued to Local Agricultural Educational Authorities the outline of the scheme for the distribution of hatching eggs and newly-hatched chicks among small-holders, cottagers, and other small poultry-keepers in rural districts. For this purpose, breeders have been selected by the Local Authorities and approved by the Ministry, and arrangements made for them to supply eggs and chicks to small poultry-keepers at somewhat lower than the usual prices charged. The approved breeders are to be known as station-holders. They are required to provide and maintain for station purposes at least 36 hens, or 24 hens and 12 ducks, of a breed or breeds to be approved by the Agricultural Education Committees. Other conditions are imposed, and it is desirable that all station arrangements should be completed before 15th December next. The County Committee will fix the prices at which the eggs or chickens, or both, may be distributed, and generally supervise the whole scheme.

Satisfactory reports have been received by the Ministry from County Committees on the working of the scheme during 1921.

The following are the numbers of eggs, chickens, etc., distributed in 1919, 1920 and 1921 :—

	Hen Eggs.	*Duck Eggs.*	*Chickens.*	*Ducklings.*
1919 ...	52,980	—	2,974	—
1920 ...	141,611	—	20,934	—
1921 ...	104,304	1,464	37,661	222

The importance of this matter will be realised when it is stated that the estimated value of poultry produce imported into Great Britain last year was approximately £36,000,000. The scope which is therefore available for the extension of home production is very great indeed, even if taken at no more than the present rate of consumption. The scheme is designed to afford an opportunity to the small poultry-keeper to improve the productive quality of his stock.

After the scheme has been adopted by any County Committee, its successful working will depend almost entirely upon the degree of care and attention given to it by the county poultry instructor, the careful selection of the station-holders, and the maintenance of robust stock of good economic strain at the stations.

The county poultry instructor will select and mark those birds at each station from which eggs and chicks are to be distributed during next season under the scheme. He will see that no breeding stock of inferior quality is maintained at any station recognised under the scheme, and that the housing and general management of the station stock are of a satisfactory nature.

Those who wish to participate in the scheme should make early application to the county authorities. They will be charged from 5s. to 7s. per dozen for eggs and from 10s. to 14s. per dozen for chickens or ducklings.

Artificial Light and Winter Egg Production.

AN experiment is to be carried out at Send Manor Poultry Farm, Ripley, Surrey, under the direction of the Scientific Poultry Breeders Association with the object of ascertaining by means of two absolutely similar flocks of birds what advantage is obtainable as regards cost of production, number and size of eggs, during the winter months, by use of artificial light. A similar experiment is also to be carried out at the Harper Adams Agricultural College, Newport, Salop, under the direction of the College Authorities.

Grants in Aid of Research and Advisory Work.*

THE Treasury, on the recommendation of the Development Commissioners, have approved grants in aid of research and advisory work to be carried out in the academic year, 1st October, 1921, to 30th September, 1922, as shown in the statement below. Provision is made, in addition to the grants shown hereunder against the respective institutes, for the payment of a cost of living bonus to the graded workers at the institutes, but in general no new staff, promotions or development of work have been sanctioned. Proposals for development under these heads must await the allocation of the sum of £850,000 available under the Corn Production Acts (Repeal) Act, 1921, for the promotion of agricultural development in England and Wales.

Institution.	*Grant* (excluding Bonus). *Research Work.*	*Advisory Work.*
	£	£
Aberystwyth, University College ...	4,690	1,090
Armstrong College	—	1,530
Bangor, University College	—	2,590
Birmingham University...	760	—
Bristol University	8,550	1,730
Cambridge University	—	1,630
Animal Nutrition	7,200	—
Plant Breeding	4,200	—
Small Animal Breeding	1,100	—
Bees...	500*	—
East Malling Horticultural Station ...	4,200	—
Harper Adams Agricultural College ...	—	580
Imperial College	3,600	—
Leeds University...	—	2,000
London School of Tropical Medicine ...	1,300	—
Manchester University	—	1,000
Midland Agricultural College	—	1,150
Oxford University	4,640	—
Reading, University College	6,100	1,280
Rothamsted—		
Plant Nutrition	13,250	—
Plant Pathology	5,000	—
Royal Veterinary College	2,050	—
Waltham Cross Horticultural Station ...	1,000	—
Wye, South Eastern Agricultural College	—	3,170
	£68,140	£17,750

* A complete list of research stations with the subjects of research undertaken at each, and of advisory officers attached to university departments of agriculture and agricultural colleges, will be found in Leaflet No. 279, obtainable from the offices of the Ministry, 10, Whitehall Place, London, S.W.1.

Testing of Agricultural Machinery.

THE Minister of Agriculture has appointed an Advisory Committee to assist the Ministry in deciding as to the general conditions which should govern the admission of agricultural machinery for tests under the auspices of the Ministry, and the principles which should be laid down as regards the duration and conditions of the tests.

The Advisory Committee will also be asked to advise upon (*a*) the different categories into which agricultural machinery should be divided for the purpose of testing; (*b*) the nature of any diploma or certificate to be awarded, having regard to the recommendations of the report of the Departmental Committee on Agricultural Machinery (Cmd. 506); (*c*) the scale of fees which should be charged, and the date from which it would be possible to charge such fees; (*d*) the constitution of panels from which the Ministry might select Boards to be charged with the duty of drawing up and revising from time to time detailed conditions applicable to the machines of the various categories; and (*e*) generally upon the arrangements to be made for the testing of agricultural machinery.

The Committee consists of representatives of the Agricultural Engineers' Association, the Dairy Appliance Manufacturers' Association, the Society of Motor Manufacturers and Traders, the National Association of Agricultural Engineers and Implement Dealers, the National Farmers' Union, the Royal Agricultural Society of England, the Central Chamber of Agriculture, the Central Landowners' Association, and the National Agricultural Labourers and Farm Workers' Union, in addition to certain agricultural scientists and experts.

The Chairman of the Committee will be Sir Douglas Newton, K.B.E., and the Secretary, Mr. P. Barker, of the Ministry of Agriculture and Fisheries.

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New Orders Dealing with Wart Disease.

THE Ministry, on the recommendation of the Potato Advisory Committee and with the approval of the Agricultural Advisory Committee, has decided to make certain changes in the Orders dealing with wart disease. The effect of them is to allow the planting of non-immune varieties of potatoes on land in wart disease infected areas, provided such land is not actually infected or known to have been infected with the disease, and to give greater protection against the spread of the disease to other districts.

As the first step, the Ministry has issued a short order amending certain sections of the Wart Disease of Potatoes Order of 1919, so as to permit the planting of any varieties of potatoes on the clean lands in infected areas. With regard to the land actually infected, or known to have been infected, the Order permits the planting therein only of those varieties which have been approved by the Ministry as immune to the disease and which have been certified by a government inspector as reasonably free from "rogues;" though, in addition, permission is given to plant on any such land seed saved from the crop grown on that land in a previous year. No licence will be required in future for the movement of seed potatoes into wart disease infected areas.

No potatoes grown outside the United Kingdom will be permitted to be planted in England and Wales unless the Ministry issues a licence allowing it.

After the close of the next planting season, a further order will be issued prohibiting the movement out of any infected area to any clean area of potatoes grown in an infected area except "ware" potatoes of immune varieties. These will be permitted to be sent to districts which are infected areas, provided they are accompanied by a statement to the effect that they are of an approved immune variety, that they were grown in an infected area, and that they will not be used for planting. This order will also provide that no seed potatoes may be sold for planting anywhere in England and Wales unless they have been certified (*a*) to be of an approved immune variety, true to type and reasonably free from "rogues," or (*b*) that they were grown on a holding which is not in an infected area and on which wart disease has not occurred.

AGRICULTURE ABROAD.

Rabbit Breeding in Belgium.

INFORMATION regarding the rabbit-breeding industry in Belgium has been obtained by Mr. P. A. Francis, of the Live Stock Branch of the Ministry, during a recent visit to that country. The Belgian Ministry of Agriculture has not had the opportunity since the War of devoting much attention to the rabbit-breeding industry, owing to the heavy work occasioned by the necessity of replacing the larger live stock. The rabbit industry is nevertheless a considerable one, as it is estimated that about seven million skins are being produced annually in Belgium. Practically all Belgian peasants, and even the townspeople, keep a few rabbits, which are mostly killed for home consumption, the skins being sold to local collectors. The remainder are sold alive, either in local markets or to travelling dealers who kill them and sell the carcasses to butchers, etc., and the skins to curers. Before the War from 150 to 200 tons of "Ostend" rabbits were sent to London from Belgium weekly; such rabbits are not chilled or carried in cold store, the object being to put them on the London market in a fresh condition.

There is a very large rabbit skin factory in Ghent, where before the War several million skins were dressed for fur, chiefly for imitation beaver, chinchilla, seal, marten and ermine, many of which were absorbed in the London market. Regarding prices, good Belgian skins recently realised 1s. 3d. each; although most of them are of no particular breed (probably a cross with the Flemish giant) they are large and they are properly dried. Belgium does not produce sufficient skins for the fur industry, and supplies are purchased in France and England. Complaints are made that the skins from England are, as a rule, so badly taken off the rabbits and so carelessly dried that they are of comparatively little value. During the War, however, as much as 12s. per dozen was paid for English wild rabbit skins, but at the present time they are worth only about a quarter of that price.

From 12,000 to 14,000 skins of the Blue Beveren breed are produced annually in Belgium, chiefly from the Province of Beveren, but not more than five francs (about 2s. 1d.) each is being paid for even the best of the skins. There appears to be an almost unlimited demand for rabbit skins of good quality for making-up purposes and for rabbit fur in its natural undyed state, but only about 25 per cent. of the skins are good

enough for either purpose. The skins produced during the summer months are of inferior quality and are mostly used for making felt for hats, but winter skins are of high quality and are eagerly sought after by the manufacturers. It is improbable, however, that rabbit production as a separate business would be profitable, even allowing for the value of the carcass, but all who are able to keep a few rabbits mainly on waste material should do so, both because they would be producing cheap food and a useful fur. In this respect the Belgian peasants and smallholders show more initiative in exploiting their opportunities than do cottagers and smallholders in this country.

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Seed Improvement in Canada.

THERE are many agencies in Canada having for their object the encouragement of the production and use of good seed. Among these may be mentioned field crop competitions, combined seed crop and cleaned seed competitions, seed fairs, provincial seed exhibitions, and seed centres, while the Canadian Seed Growers' Association and the Dominion and Provincial Departments of Agriculture take a leading part in the movement.

In the April and June issues of this *Journal* an indication of the methods adopted to improve the Canadian wheat crop by means of breeding new varieties and distributing them to farmers at low cost was given. Further particulars of the campaign for good seed, including crops other than wheat, are contained in the *Agricultural Gazette of Canada* for March-April last. The Experimental Farms Branch of the Dominion Department of Agriculture has a number of Illustration Stations in various parts of the country. An example of the value of these stations is cited: farmers in the vicinity of a station were induced last year to grow 850 acres of *clover seed*, estimated to be worth \$50,000 more than would have been the case with the regular crop. The distribution of *tobacco seed* by the Dominion Department has been one of the chief contributory causes of the increasing value and importance of the tobacco industry of Canada: while the extension of the *flax* industry, both in connection with fibre and seed, is largely due to the activity of the Flax Division of the Experimental Farms Branch.

The Seeds Branch promotes the greater production and use of first-quality seed in several ways. In addition to its seed inspection service, which helps to prevent the sowing of dirty, non-vital seeds, it supports the Canadian Seed Growers' Associa-

tion in its work of producing registered seed, it provides a service of market intelligence to growers, and it pays cash subventions to the Provincial Departments of Agriculture.

The combined seed crop and cleaned seed competitions, which are a recent introduction, have two distinct phases. The first consists of a standing field crop competition; the second of a thrashed and cleaned seed competition, in which the seed is judged in the granaries of the competitors, after thrashing. Awards are based on the combined scores—35 per cent. on the field score, 65 per cent. on the bin score. The cleaned seed part of the competition is thus recognised as the more important. This system of awarding prizes now applies to all seed crops, except potatoes, in which case the basis is reversed, namely 65 per cent. on the field score and 35 per cent. on the bin score. The foundation seed used by competitors must be of approved origin, that is, it must have been either registered or approved by the seed committee of the Province; the minimum quantities of cleaned seed submitted vary from 15 bushels in the case of clovers and timothy to 200 bushels in the case of oats.

The primary object of these combined competitions is to encourage the development of commercial seed centres such as are promoted by the Canadian Seed Growers' Association and other organisations. The demand for superior quality seed has grown materially during the last few years, and it is claimed that the combined competitions stimulate the production of the special kinds of seeds most suitable to the different localities, this being the chief purpose of the seed centres.

With regard to *potatoes* the Markets Division of the Seeds Branch has made a detailed survey of available supplies. It knows the location, quantity and varieties of the seed, all of which is the product of fields inspected by trained pathologists. To be eligible for certification the growing crop must pass the Department's inspection standard for freedom from disease, and purity of variety. They are then graded, sacked, sealed and marketed on the basis of the Department's certificate. Comparative yields from certified seed and common local stock seed are well illustrated by the results of the 1920 demonstrations in Ontario. For instance, Green Mountain certified seed from New Ontario gave a yield of 218.3 bushels per acre, as compared with 189.2 bushels per acre from common stock.

AGRICULTURAL RETURNS, 1921.

PRODUCE OF CROPS IN ENGLAND AND WALES.

The following Memorandum on the Agricultural Returns of England and Wales for 1921 was issued by the Ministry on 2nd November:—

Winter corn was drilled into a good seed bed and spring sowing was also carried out under good conditions, though some heavy soils became baked and the seed beds consequently rough. The autumn-sown crops stood the long drought very well, and those sown early in the spring remained satisfactory, but late sowings, especially on rough land, suffered very considerably. Spring corn generally was short in the straw. Beans were damaged by fly, and peas did not fill very well owing to the drought. Crops were harvested under very favourable conditions generally, only a little corn in the north and west being damaged by wet. The grain is of good quality, except in the case of late sown spring crops, which gave small, thin grain.

The total production of wheat in England and Wales is estimated at 8,723,000 quarters, which is rather more than 2,000,000 quarters greater than in 1920, and larger than in any year since 1898, with the exception of 1918, when the area of this crop was greatly increased as a result of the Food Production Campaign. The yield per acre over the whole country is estimated at 35·3 bushels, or nearly 5 bushels above the average of the previous 10 years, and the highest recorded since official returns of production were first collected in 1885. The total production of barley is 5,309,000 quarters, or 1,000,000 quarters less than in 1920 and 350,000 quarters less than the average of the 10 years 1911–20. The yield per acre is estimated at 29·6 bushels, which is about 1½ bushels per acre below the 10-year average. Oats were also a light crop, the yield per acre being estimated at 37·3 bushels, which is over 1 bushel per acre below average, and half-a-bushel less than last year. The total production, which amounted to 10,022,000 quarters, is about 700,000 quarters less than in 1920. In some districts there were many very poor fields of oats, and also of barley, but there were, however, a large number of crops which did well and thrashed out better than was expected. The yield of mixed corn is estimated at 33·8 bushels per acre, and the total production at 570,000 quarters, or 30,000 quarters less than in 1920, when the acreage was larger. The total production of beans is, apart from 1917, the smallest since 1904, and, at 778,000 quarters, is 180,000 quarters less than last year. The yield per acre is estimated at 26·2 bushels, which is 1 bushel below average and about 5 bushels less than in 1920. The yield of peas was also poor, being only 23·7 bushels per acre, or about 1⅛ bushels below the 10-year average, and the total production, 313,000 quarters, is 130,000 quarters less than last year.

Hay suffered considerably from the very dry spring, and the total crop is one of the lightest recorded. The crop, however, was well secured, and is of good quality. Seeds' hay yielded 24·4 cwt. per acre, which is 4 cwt. per acre below average, and lower yields per acre have only been recorded six times in the last 35 years. The total production was 2,142,000 tons, or 440,000 tons less than last year. The yield of meadow hay was about 15·8 cwt. per acre, or 6 cwt. per acre below average. Crops were bad in all parts of the country.

The total production is estimated at 3,197,000 tons, or 2,430,000 tons less than in 1920, and this and the yield per acre are the lowest recorded except for the year 1893. The total quantity of hay produced is thus about 5,340,000 tons, which is about 35 per cent. less than last year, and about 2,000,000 tons less than the average of the 10 years 1911–20.

The estimate of the hop crop was issued on 20th October.* The estimates of the potato and root crops will be issued later in the year.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1921.

PRELIMINARY STATEMENT showing the Estimated Total Produce and Yield per Acre of the CORN, PULSE and HAY CROPS in England and Wales in the Year 1921, with Comparisons for 1920, and the Average Yield per Acre of the Ten Years 1911-1920.

—	Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1911—1920.
		1921.	1920.	1921.	1920.	1921.	1920.	
ENGLAND AND WALES.		*Qr.*	*Qr*	*Acres.*	*Acres.*	*Bush.*	*Bush.*	*Bush.*
	Wheat	8.723,000	6.669,000	1.976.203	1,874,585	35·3	28·5	30·5
	Barley	5.309.000	6,335,000	1.435.524	1,636,960	29·6	31·0	31·0
	Oats .. .	10,022 000	10,746,000	2.147.421	2,265,624	37·3	37·9	38·4
	Mixed Corn ..	570.000	606,000	134.898	146,324	33·8	33·1	—
	Beans	778.000	957,000	237.182	246,314	26·2	31·1	27·2
	Peas	313 000	443,000	105.699	120,311	23·7	27·4	25·0
		Tons.	*Tons.*			*Cwt.*	*Cwt.*	*Cwt.*
	Seeds' Hay* ..	2.142.000	2,584,000	1,757,474	1,674,442	24·4	30·9	28·4
	Meadow Hay† .	3,197,000	5,627,000	4,052,505	4,394,948	15·8	25·6	21·8
ENGLAND.		*Qr.*	*Qr.*			*Bush.*	*Bush.*	*Bush.*
	Wheat	8.586,000	6,515,000	1.937.453	1,824,037	35·5	28·6	30·5
	Barley . ..	5.069 000	5,982,000	1.355.773	1,537,735	29 9	31·1	31·1
	Oats .	9.267 000	9,846.000	1.932.063	2,016,531	38 4	39·1	39·0
	Mixed Corn ..	496,000	512,000	114,003	120,571	34 8	34·0	—
	Beans ..	774 000	950,000	235,910	244,456	26·3	31·1	27·2
	Peas	312,000	442,000	105.362	128,744	23 7	27·5	25·0
		Tons.	*Tons.*			*Cwt.*	*Cwt.*	*Cwt.*
	Seeds' Hay ..	1,953.000	2,327,000	1,568.492	1,486,149	24·9	31·3	28·7
	Meadow Hay ..	2.842 000	5,071,000	3.569,033	3,902,520	15·9	26·0	22·0
WALES.		*Qr.*	*Qr.*			*Bush.*	*Bush*	*Bush.*
	Wheat	137.000	154,000	38.750	50,548	28 3	24·8	27·5
	Barley	240.000	353,000	79.751	99.225	24·1	28·5	30·1
	Oats	755.000	900,000	215 358	249,093	28 1	28·9	34·2
	Mixed Corn ..	74.000	94,000	20.895	25,753	28·4	29·2	—
	Beans	3.700	6,900	1,272	1,858	23·5	29·5	27·4
	Peas	800	1,500	337	567	19·8	22·2	22·3
		Tons.	*Tons*			*Cwt.*	*Cwt.*	*Cwt.*
	Seeds' Hay ..	189.000	257,000	188 982	188,293	20·0	27·3	25·3
	Meadow Hay ..	355.000	556,000	483.472	492.428	14·7	22·6	19·8

* Hay from Clover, Sainfoin, and Grasses under rotation. † Hay from Permanent Grass.

This *Journal*, November, 1921, p. 767.

Past issues of the "Journal" and "Journal Supplements" for sale.—Readers of this *Journal* whose sets are incomplete may still obtain missing copies from the Ministry at the original prices. Most of the copies available are in good condition, but in some instances only one or two are in stock. *Supplies of the following are exhausted:*—

Vol. II, No. 4. Vol. IV, No 3. Vol. IX, No. 2.

Applications, with remittances, should be addressed to The Ministry of Agriculture, 10, Whitehall Place, London, S.W. 1. The prices are:—

Vols. I to IV	6d. per single copy	(quarterly)	post free.
" V to X	1s. " " "	"	
" XI to XXVI (No. 9)	4d. " " "	(monthly)	
" XXVI (No. 10) to XXVII	6d. " " "	"	

Copies of *Journal Supplements* are also available, excepting Nos. 4. and 8. A list of these, with prices, may be obtained on application.

Storage of Potatoes.—Owing to the abnormal climatic conditions which have prevailed during the past growing season, large quantities of immature potato tubers are now being harvested in many parts of the country. Under the most favourable conditions of ripeness, there is always some danger of decay in the pits (clamps). This winter, potato tubers may be expected to fall a prey to unsuitable conditions of temperature and fungoid attack more readily than in a normal season. Potato growers are therefore advised to defer the final soiling-up of their clamps for as long a period as the conditions of external temperature (frost) will warrant, and thus obviate as far as possible high temperatures in the clamps immediately after storing.

All growers would do well to consult the article entitled "Causes of decay in Potato Clamps" in the Supplement to the Ministry's *Journal* of March, 1919, commencing page 48.

Disease in Geese from Poland.—Some thousands of geese have recently arrived in this country from Poland and are being fattened on farms in several counties. The Ministry desires to inform farmers and poultry-keepers that cases of a disease which appears to be Fowl Cholera have broken out in certain batches of these geese. The disease is infectious and therefore liable to spread amongst other poultry stock upon the farm or occupation. From present reports, the geese die after two or three days' illness, the symptoms being drooping wings, sunken eyes, rapid loss of condition, weak gait, and, sometimes, diarrhœa.

The Ministry is making immediate enquiries into the matter with a view to a definite diagnosis of the disease and the discovery of all localities in which it exists. Meanwhile, any persons having imported geese on their land are advised to communicate at once with the Ministry, at No. 10, Whitehall Place, London, S.W.1, should the disease make its appearance amongst the bird stock on their premises. If death occurs in any case, a specimen carcass should be sent without delay to the Ministry's Veterinary Laboratory, New Haw, Weybridge (Addlestone Station, L & S.W.R.); it should be securely packed and covered, with the name and address of the sender upon it, other particulars being sent by post.

The Seeds Act, 1920.—Under the Seeds Act, 1920, all tests for the purpose of a Declaration under the Act, except in the case of garden seeds, must be made either at one of the Official Seed Testing Stations, or at a Private Station

licensed by the Ministry for that purpose. A Declaration based on a test carried out at a non-licensed station is, therefore, illegal.

The Ministry had already announced that arrangements could not be made for any further inspections this year of establishments for which a license was desired; but as it was understood that the announcement passed unnoticed by a number of firms who always made it a practice to test their cereal seeds before delivery to their customers, it was decided to extend the period, during which applications for licenses to test cereal seeds only might be made, to 5th November, 1921.

Licenses will be issued only in cases where the Ministry is satisfied that the equipment and management of the establishment is in every way adequate for the proper carrying out of tests, and only for the purpose of testing seeds required by the licensee for his own purchases and sales.

International Year-Book of Agricultural Legislation, 1920.—The International Institute of Agriculture, Rome, has recently issued its tenth Year-Book of Agricultural Legislation. The volume contains an introduction in English, in which the general course of the legislation of the world in 1920, bearing upon agriculture, is outlined. The remainder of the volume, in French, gives, in summarised form and under their relative subject heads, the various agricultural enactments, decrees and statutory orders of the chief countries of the world.

The price of the publication is 11s. 11d. Remittances should be forwarded to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W. 1.

The London Thoroughbred Stallion Show for 1922.—The Ministry gives notice that a Show of Thoroughbred Stallions will be held, in conjunction with the Hunters' Improvement and National Light Horse Breeding Society, at the Royal Agricultural Hall, Islington, on 28th February, 1st and 2nd March, 1922.

A Challenge Cup presented by H.M. The King will be awarded for the Champion Stallion in the Show; and a Gold Medal will be awarded by the Ministry to the owner. 60 King's Premiums (including 12 Super-Premiums) will also be offered for award by the Ministry.

In addition to the King's Premiums, a very limited number of Ministry's Premiums will be available for award on the recommendation of the County Horse Breeding Committees. These awards will not be made, however, until the routes of the King's Premium Stallions have been arranged.

Agricultural Research Scholarships and Fellowships.—The Ministry, on the recommendation of the Advisory Committee on Agricultural Science, and with the approval of the Development Commissioners and the Treasury, has awarded *Research Scholarships* of the value of £200 per annum to the following candidates :—

Mr. A. E. Watkins, B.A., Cambridge (Botany), for two years.

Mr. D. Cuthbertson. B.Sc., Glasgow (Chemistry), for one year.

Mr. R. A. Glover, M.A., B.Sc., Edinburgh (Veterinary Science), for two years.

Mr. T. W. M. Cameron, M.R.C.V.S., Royal Veterinary College (Veterinary Science), for two years.

Travelling Research Fellowships of £250 each have been awarded to :—

Mr. B. A. Keen, Soil Physicist at the Rothamsted Experimental Station, for a visit to America in the Autumn of 1921.

Professor R. G. Stapledon, Director of the Aberystwyth Plant Breeding Station, for a visit to America in 1922.

The Scholarships have been established to assist promising candidates to qualify as research workers with a view to their contributing to the development of agricultural and veterinary research.

Travelling Fellowships were instituted last year to enable selected members of the staffs of research institutes aided by the Ministry to visit institutions abroad where work on similar or cognate subjects is carried on and to study at first hand the methods employed there.

Leaflets issued by the Ministry.—Since the date of the list given on page 763 of the November issue of the *Journal*, three new leaflets have been issued :—

No. 370.—Nitrogenous Manures.
„ 371.—The Packing of Eggs for Hatching and the Management of the Sitting Hen.
„ 377.—" Reversion " or Nettlehead of Black Currant.

The following leaflets have been re-written :—

No. 4.—Winter Moths.
„ 41.—Red Spiders.
„ 98.—Grading and Packing of Apples.

The following have been revised :—

No. 105.—Wart Disease.
„ 162.—Propagating Apples, Pears, Plums, and Cherries.
„ 255.—The Workmen's Compensation Act, 1906.
„ 279.—Technical Advice for Farmers.
„ 290.—The Cattle Testing Station of the Ministry of Agriculture and Fisheries.
„ 352.—The Control of Pests of Fruit Trees in Gardens and Small Orchards.

The following has been withdrawn :—

F.P. 53.—Storage of Sulphate of Ammmonia.

Distribution of Leaflets.—The leaflets issued by the Ministry have hitherto been issued free of charge, but in view of the increased cost of printing and paper, and the need for economy in Government expenditure, it has been decided that a charge must in future be made in all cases where more than one (or at the most two) leaflets are required.

Persons who require information on a definite point dealt with in one of the leaflets can therefore obtain the leaflet in question free of charge, but if several leaflets are required, a charge will be made at the rate of 1d. each or 9d. per dozen, post free. Where groups of leaflets dealing with specific subjects are required, the new Sectional Volumes of leaflets should be purchased

Leaflets required by Agricultural committees, local education authorities, agricultural colleges, farm institutes, farmers' clubs, allotment societies, etc., for distribution, will be supplied at the rate of 4s. per 100, carriage free.

Sectional volumes, any bound sets of leaflets, and miscellaneous publications, will be supplied in quantities of 20 and upwards to the above-mentioned bodies (but not to private individuals) at 10 per cent. discount on the published price.

QUESTIONS IN PARLIAMENT.

Warble Fly.—Sir B. Stanier asked the Minister of Agriculture whether he could give any information regarding the findings of the committee to investigate the warble fly problem; and whether they had found any new preventative?

Sir Arthur G. Boscawen: The investigations of the committee appointed to report on the warble fly are not yet completed, but I am advised that the committee are very hopeful that an effective preventive against attacks of this pest has been discovered. Experiments have recently been tried with a wash composed of tobacco powder mixed with lime, and very encouraging results have been obtained. (October 20, 1921.)

Unfit Horses (Export).—Capt. W. Benn asked the Minister of Agriculture whether the inspectors appointed to inspect horses about to be exported can order unfit animals to be destroyed and enforce such orders?

Sir Arthur G. Boscawen: Yes, Sir. Section 1 of the Exportation of Horses Act, 1914, empowers the veterinary inspector to slaughter or cause to be slaughtered, whether the owner consents to such slaughter or not, any horse examined by him which he finds to be in such a physical condition that it is cruel to keep it alive or which is permanently incapable of being worked without suffering. The Act provides no appeal against the inspector's decision, which can be duly enforced. (October 20, 1921.)

In reply to a question by Sir J. Butcher, Major Barnston, on behalf of the Minister, stated that the measures which have been adopted by the Ministry to raise the standard of fitness of horses exported to the Continent have resulted in stopping the export trade in worn-out horses, and in restricting the trade to horses which are fully fit to work. The high standard of fitness now enforced has also resulted in the slaughter in this country of a much larger proportion than formerly of horses which are intended for food on the Continent. As a result of conferences which took place between the Ministry and representatives of the Dutch and Belgian Governments during the past summer, dressed carcasses of horses slaughtered in this country and officially inspected will be accepted in Holland and Belgium. (October 25, 1921.)

Railway Rates (Agricultural Produce.)—In reply to a question by Mr. Royce regarding railway rates for agricultural produce, the Parliamentary Secretary to the Ministry of Transport said that in the general increase in railway rates which took effect in January, 1920, certain classes of fertilisers and agricultural produce were either exempted from increase or were subjected to a lower rate of increase than other traffic, as recommended by the Rates Advisory Committee. On reviewing the rates in

July, 1920, the same Committee did not see their way to recommend the continuance of these concessions to agriculturists, and the charges on agricultural produce were, therefore, increased in September, 1920, by the same percentage over 1919 rates as applied to other merchandise in the same classification, with the exception that the increase on specified manures was limited to 50 per cent. The provisions of the Agriculture Act, 1920, had no bearing on the matter: the increased rates of September, 1920, were intended to secure sufficient additional revenue in 11 months to produce financial equilibrium over the last 16 months of control, but the depression in trade and the coal stoppage largely defeated this aim and rendered any general reduction in rates before the end of Government possession impracticable. It is, however, open to the agricultural interests to make application to the Rates Tribunal under Section 60 of the Railways Act, 1921, for a reduction in existing rates, if they so desire. (October 25, 1921.)

Corn Production Acts (Subsidy Claims.)—In reply to a question by Mr. Glanville, Sir Arthur G. Boscawen stated that the total number of claims received is approximately 194,000, relating to 1,937,000 acres of wheat, 2,063,000 acres of oats, and 130,000 acres of mixed corn. The investigation of the claims will not be completed for some time yet. These figures, therefore, include some duplicate and other inadmissible claims. (October 24, 1921.)

In reply to a question by Mr. A. Herbert, the Minister of Agriculture stated that the interpretation of Section 1 of the Corn Production Act, 1917, as regards fractions of an acre has been referred by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland, jointly, to the Law Officers of the Crown, for both countries for their opinion. The Law Officers have advised that the Departments are not liable to make any payments in respect of fractions of an acre, and that they have no power by Regulation to legalise such payments. (October 31, 1921.)

Land Settlement.—Mr. C. White asked how many men had been settled on the land under the Land Settlement Acts from 1st January, 1919, to 1st October, 1921?

Sir Arthur G. Boscawen: Complete returns of Michaelmas lettings are not yet available, but the total number of men settled on the land by councils between the dates mentioned is estimated to be 15,750, to which should be added 712 provided with holdings or employed on the Ministry's farm settlements. Of the total number thus settled, 14,786 are ex service men. (October 24, 1921.)

Fertilisers.—In reply to a question by Mr. Gardiner, Sir Arthur G. Boscawen stated that the prices at which fertilisers may be sold in the United Kingdom are not now controlled by the Government in any way. Supplies of all the principal fertilisers are, it is understood, more than sufficient to meet the demand, and considerable reductions in price have taken place during the last few months. There is no reason to suppose, therefore, that farmers will be asked to pay unreasonable prices for their fertilisers next season. (October 24, 1921.)

Potatoes (Diseases).—Mr. Gardiner asked whether he was aware that very large quantities of potatoes were being offered from countries where there was no inspection for wart or other infectious diseases; and whether he would take such action as would protect this country from the danger of such

diseases being spread over very large areas now quite free from such contamination?

Sir Arthur G. Boscawen: Arrangements are made in most countries for the inspection of potatoes which are intended for export, and consignments are then accompanied by certificates of health issued by the Government of the country concerned. By an order of the Ministry issued under the Destructive Insects and Pests Acts, which came into operation on 1st October, 1921, potatoes imported into this country without an official certificate as to their freedom from disease are liable to examination, and if found to be unhealthy may be either re-exported or destroyed. (October 24, 1921.)

Canadian Cattle.—Sir B. Stanier asked the Minister of Agriculture for the number of milch cows, yearlings and two-year-old steers and calves in Canada in the years 1919, 1920 and 1921.

Sir Arthur G. Boscawen. The number of cattle in Canada in June, 1919, as published by the Dominion Government, was as follows:

Bulls	300,471
Milch Cows	3,548,437
Calves	2,424,299
Steers	840,319
Other Cattle	2,971,555
Total ...	10,085,081

The Dominion Government have published the following figures of the number in June, 1920:

Milch Cows	3,530,238
Other Cattle	5,947,142
Total ...	9,477,380

Further details in regard to 1920 have not yet been published. Figures for 1921 are not yet available.

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NOTICES OF BOOKS.

Birds One Should Know—Beneficial and Mischievous.—(The Rev. Canon Theodore Wood: illustrated by Roland Green, F.Z.S. Gay & Hancock, Ltd, 34, Henrietta Street, Covent Garden, London, W.C. 2. Price 10s. 6d. net.) The influence of the country's fauna on crop production for good or evil is so great that works approaching the subject from this point of view are welcome. The book under notice, with the help of its lavish illustrations, will enable readers to identify the more common birds of the countryside—"birds one should know," as the title rightly indicates. Together with a short outline of habits, a few words are said which attempt to give the subjects chosen their character as beneficial or the reverse. With birds this is a difficult matter, and it may be suspected that the author has found it so. Even with the more exact information which is gradually being amassed as to the food of birds, the position of several species is still difficult to appraise. With a number it is easy to say they are all good, but with few is it possible to say they are all bad and with many it is difficult to decide upon which side lies the

balance of utility or harm. The author of this book, however, has approached his task in a fair and impartial spirit.

In such a controversial subject it would be strange if some grounds, however small, were not found for criticism. The sparrow seems to get more and the bullfinch less than a fair meed of praise, the aphid-eating propensities of the latter not being mentioned. Also, the thistleheads on the frontispiece would surely have been better shown with the seeds in a ripe condition!

What the author considers to be salient points about each bird are given shortly and concisely, and the plates and text figures lose nothing by being produced in an artistic and attractive form.

Ministry's Register of Dairy Cows with Authenticated Milk Records.—The Fourth Volume of the Ministry's Annual Register of Dairy Cows with authenticated Milk Records is now available. It contains particulars, including a list of the owners and breeders, of 5,147 cows in respect of which certificates have been issued by the Ministry showing that they have yielded 8,000 lb. or over of milk during the milk recording year ended 1st October, 1920, or an average of 6,500 lb. for that year and one or more preceding consecutive years. The existence of this register is not as widely known as it ought to be, but a growing appreciation of its usefulness is indicated by the fact that the number of entries in the fourth volume is about ten times that in the first volume, and the number of owners whose cows are entered has multiplied nearly eight times.

Sixteen recognised breeds or types are represented in the fourth volume, as compared with only five in the first volume, and there are in addition 459 cross-bred cows (*i.e.*, cows which do not conform to one recognised breed or type) whose milk yields have justified their inclusion under the standard required. Of the 5,147 cows entered in the fourth volume, 4,080 gave over 8,000 lb. of milk during the year, and the remainder were entered on an average of 6,500 lb. or over. Of the 4,080 cows which were entered on the one year's yield 2,115 gave between 8,000 and 9,000 lb.; 1,050 between 9,000 and 10,000 lb.; 534 between 10,000 and 11,000 lb.; 218 between 11,000 and 12,000 lb.; 80 between 12,000 and 13,000 lb.; 44 between 13,000 and 14,000 lb.; 17 between 14,000 and 15,000 lb.; 9 between 15,000 and 16,000 lb.; 7 between 16,000 and 17,000 lb.; 2 between 17,000 and 18,000 lb.; 2 between 18,000 and 19,000 lb.; and 2 between 20,000 and 21,000 lb.

The objects of this register are (1) to assist and encourage the breeding and improvement of dairy cattle of any breed, type or cross by providing authentic records of cows which have been proved to possess high class dairy qualifications, (2) to bring sellers and buyers together, and (3) to record particulars of the breeding of cows so as to encourage the use of pedigree bulls for grading up non-pedigree herds which may thus become eligible for recognised herd books in due course. To enable a cow to be entered in a herd book, evidence is needed to prove that the foundation cow was an animal of the breed to which the herd book refers, and that her descendants were sired by pedigree bulls of that breed.

Many dairy farmers, before purchasing a cow, now insist on obtaining a proof of her milk yield in the past, and there is no doubt that increasing importance is being attached by them to the milk records of cows offered for sale. To verify this statement, one has only to notice the enhanced prices obtained for those cows (and progeny) whose milk records have been certifi-

cated by the Ministry or entered in the Register of Dairy Cows. Breeders of dairy cattle and persons about to start or replenish a dairy herd would be well advised, therefore, to make the fullest use of the information afforded by the register.

Copies of the fourth volume of the register may be obtained on payment of 10s. (10s. 9d. post free) either direct from the Ministry at 10, Whitehall Place, S.W.1, or through any bookseller from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Fabre, J. H.—"The Story of the Fields." (271 pp.) London: Hodder & Stoughton, Ltd., 1921, 8s. 6d. [63(022).]

U.S. Department of Agriculture.—Department Circular 152:—Organization and Result of Boys' and Girls' Club Work. (8 pp.) Washington, 1921. [372.]

Cherry, T.—Victorian Agriculture: A Textbook of the Principles and Methods underlying the Pastoral and Agricultural Industries of South Eastern Australia. (301 pp.) Melbourne: Paterson & Co., 1913. [63(945).]

Weir, W. W.—Productive Soils. [Lippincott's Farm Manuals.] (398 pp.) Philadelphia & London: J. B. Lippincott Co., 1920, 10s. 6d. [63.1.]

King, J. S.—The Determination of Farm Profits. (12 pp.) Loughborough: The Midland Agricultural & Dairy College, 1921. [657.]

British Association for the Advancement of Science.—The Advancement of Science, 1921. Addresses delivered at the 89th Annual Meeting at Edinburgh, September, 1921. (230 pp.) London: John Murray, 1921, 6s. [06; 37(04).]

Dachnfeldt, L.—Vejledning i Havefroavl. (2nd Edition.) (275 pp.) Odense: Milo'ske Boghandels Forlag, 1919. [63.5(02); 63.1951.]

Farmer, R. C.—Industrial and Power Alcohol. (110 pp.) London: Pitman & Sons, 1921, 2s. 6d. net. [663.5.]

Tweedy, R. N.—Industrial Alcohol. (88 pp.) Dublin: Co-operative Reference Library, 1917, 1s. [63.344; 663.5.]

Weaver, Sir L.—Land Settlement Building Work of the Ministry of Agriculture and Fisheries. Extract from Journal of the Royal Inst. of Brit. Architects, Vol. XXVIII, No. 11, 1921. (309-340 pp.) London, 1921, 1s. 6d. [325; 69(02).]

Department of Scientific and Industrial Research. Fuel Research Board.—The Winning, Preparation and Use of Peat in Ireland. Reports and other documents. (76 pp.) H.M. Stationery Office, 1921, 3s. [662.6.]

Falk, K. G.—The Chemistry of Enzyme Actions. (136 pp.) New York: Chemical Catalog Co., 1921. [54(02).]

Atkinson, A. G. B.—Tithe Rentcharge. (21 pp.) London: Society for Promoting Christian Knowledge, 1921, 1s. net. [348.]

Mairet, Ethel M.—A Book on Vegetable Dyes. (148 pp.) (3rd Edition.) Ditchling, Sussex: S. Dominics Press, 1920, 5s. [63.342.]

Field Crops.

Newsham, J. C.—Crops and Tillage. (186 pp.). London: Methuen & Co., Ltd., 1921, 6s. net. [63.3(02); 63.19.]

Cunningham, J. C.—Products of the Empire. (299 pp.) Oxford: Clarendon Press, 1921, 5s. 6d. [63(022); 31(42).]

Myrick, H.—The Hop: Its Culture and Cure, Marketing and Manufacture. (300 pp.) New York: Orange Judd Co., 1914. [63.3451.]

Murke, F.—Beet Sugar: Condensed Description of its Manufacture. (175 pp.) New York: J. Wiley & Sons, 1921, 15s. [664.1.]

Tennessee Agricultural Experiment Station.—Bull. 12:—Lespedeza (Japan Clover). (28 pp.) Tennessee, 1921. [63.33(b).]

Horticulture.

Wright, S. T.—Fruit Culture for Amateurs. With Notes on Injurious Insects and Fungi by W. D. Drury. (116 pp.) (5th Edition.) London: "The Bazaar Exchange & Mart" Office, 1s. 6d. net. [63.41(02).]

Hayes, F. C.—A Handy Book of Horticulture. (225 pp.) London: J. Murray, 1921, 5s. [63.5(02).]

Hodge, J. M.—Raspberry Growing in Scotland. (118 pp.) Edinburgh: The Scottish Smallholders' Organisation, Ltd., 1921. [63.41 (c).]

Bunyard, E. A.—A Handbook of Hardy Fruits: Apples and Pears. (204 pp.) London: John Murray, 1921, 7s. 6d. [63.41(a).]

Bretignière, L.—La Pomme de Terre et le Topinambour (Jerusalem Artichoke). (200 pp.) Paris: Librairie Agricole de la Maison Rustique, n.d., 7 fr. 50. [63.511; 63.512(02).]

Plant Diseases.

New York Agricultural Experiment Station.—Bulletin 475:—Insect Injuries in Relation to Apple Grading. (42 pp.) Geneva, 1920. [63.27-41.]

Arkansas Agricultural Experiment Station.—Bulletin 167:—The Mosaic Disease of Sweet Potatoes. (10 pp. and Plates.) Fayetteville, 1920. [63.24.]

Sanderson, E. Dwight.—Insect Pests of Farm, Garden and Orchard. (2nd Edition, Revised and Enlarged by L. M. Peairs.) (707 pp.) New York: John Wiley & Sons; London: Chapman & Hall, 1921, 26s. net. [63.27(02).]

Live Stock.

Kansas Agricultural Experiment Station.—Circular 89:—Swine Feeding Investigations, 1919-20. (10 pp.) Manhattan, 1921. [63.645.]

Washington Agricultural Experiment Station.—Bull. 157:—Pea Straw for Fattening Beef Cattle. (24 pp.) Washington, 1920. [63.625.]

Veterinary Science.

Michigan Agricultural Experiment Station.—Technical Bulletin 49: Studies in Infectious Abortion. (30 pp.) East Lansing, 1920. [619.2(a).]

Dairying and Food, General.

Dairy Farming on Arable Land: Five Prize Essays. (144 pp.) Liverpool: R. Silcock & Sons, Ltd., 1921. [63.70(02).]

Newsham, J. C.—"Dairy Farming." (Housing, Feeding, Breeding, Milk, Butter and Cheese.) (174 pp.) London: C. Arthur Pearson, Ltd., 1920, 3s. 6d. [63.70(02).]

Mortensen, M.—Management of Dairy Plants. (358 pp.) New York: The Macmillan Co., 1921. [63.718.]

U.S. Department of Agriculture.—Bulletin 970:—Manufacture of Cows'-Milk Roquefort Cheese. (28 pp.) Washington, 1921. [63.736.]

South Dakota Agricultural Experiment Station.—Bulletin 188:—Relative Values of Feed Proteins for Dairy Cows. (163-204 pp.) Brookings, 1920. [612.394; 63.711(04).]

Plimmer, R. H. A. (War Office Directorate of Hygiene).—Analyses and Energy Values of Foods. (255 pp.) London: H.M. Stationery Office, 1921, 6s. net. [612.39.]

Agricultural Costings Committee.—Final Report on an Investigation into the Cost of Milk Production. (18 pp.) H.M. Stationery Office, 1921, 3d. net. [63.714.]

Harrow, D. B.—Vitamines. (219 pp.) London: Geo. Routledge & Son, Ltd., 10s. 6d. [612.39.]

Natural History, Birds, Poultry and Bees.

British Museum (Natural History).—Furniture Beetles: Their Life History and How to Check or Prevent Damage Caused by the Worm, *C. J. Gahan*. (23 pp.) London, 1920, 6d. [59.169(c).]

British Museum (Natural History).—Economic Series No. 12:—The Cockroach: Its Life History and How to Deal With It, *F. Laing*. (18 pp.) London, 1921, 6d. [63.27.]

Brues, C. T.—Insects and Human Welfare. (104 pp.) New York: Harvard University Press, 1920, $2.50. [59.169; 59.57.]

Arkansas Agricultural Experiment Station.—Bulletin 168:—The Influence of Age of Hens on Egg Production. (8 pp.) Fayetteville, 1919. [63.651(04).]

Brown, E.—The Poultry Keeper's Vade-Mecum. (170 pp.) London: Stanley Paul & Co., 1921, 2s. 6d. net. [63.651(02).]

New Jersey Agricultural Experiment Station.—Circular 115:—Standard Poultry Houses. (23 pp.) New Brunswick, 1921 [63.6 : 695.]

Barron, T. and Leigh, J N. The Daily Mail Poultry Book. (142 pp.) London: Associated Newspapers Ltd., 1921, 3s. 6d. net. [63.651(02).]

Mace, H.—A Book about the Bee (138 pp) London: Hutchinson & Co., 1921, 4s. [63.81(02); 63.81:09.]

Royal Society of Edinburgh.—Transactions, Vol. LII, Part IV, (No.29):—Isle of Wight Disease in Hive Bees. (737-779 pp.) Edinburgh: R. Grant & Son; London Williams & Norgate, 1921, 9s. [63.81-09.]

Incorporated Vermin Repression Society.—The Rat and How to Kill Him, *A. E. Moore.* (26 pp.) London: J. Bale, Sons and Danielson, Ltd., 1921, 9d net [63.269.]

Engineering.

Profiteering Acts Department.—Report on Agricultural Implements and Machinery. (10 pp) H M. Stationery Office [Cmd. 1315.], 1921, 2d. [63.17.]

Porter, J. Edward.—Activated Sludge Process of Sewage Treatment. Bibliography. (117 pp.) Rochester, N.Y.: General Filtration Co., 1921. [628.2; 01.]

Whitman, Roger B.—Tractor Principles: The Action, Mechanism, Handling, Care, Maintenance and Repair of the Gas Engine Tractor. (267 pp.) New York and London. D. Appleton & Co, 1920, $2.00. [63.17.]

Jeffery, J. A.—Text Book of Land Drainage. (256 pp) New York: The Macmillan Co., 1921, 10s. 6d. [63.14(02).]

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 10.

JANUARY, 1922.

NOTES FOR THE MONTH.

Conciliation Committees.

THE principle of collective bargaining in regard to agricultural wages which was introduced into the industry by the Corn Production Acts (Repeal) Act has now been tested in a large number of counties in England and Wales, and, although difficulties have been met with, progress on the whole has been more rapid than might have been expected. At a time like the present when the industry is experiencing an unprecedented fall in values, the conciliation machinery is of exceptional value, though the very fact that it is of value and is needed makes its use and application more difficult in practice.

The agreements which have been made up to now have in most instances been for short periods only, but as the industry tends to become more settled and the principle of the conciliation committees is better understood, agreements for longer terms will no doubt be reached, and the inconveniences arising from constant revision of rates will be removed.

Little use has been made during the past three months of the provision in the Act enabling agreements to be confirmed and thus made legally binding. Here again experience may show that there are substantial advantages in confirmation.

One provision in the Act which is for the moment practically a dead letter is the one enabling committees to elect an independent chairman, with or without power to vote. On the other hand many committees have invited a representative of the Ministry to attend their discussions and it has been found that the assistance and co-operation of an independent person not directly connected either with employers or employed is of the greatest value.

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(40641) P.14/35. 11,500. 12/21. M. &S. A

The Monthly Agricultural Index Number.

THE index number of the prices of agricultural produce, which is prepared each month by the Ministry, and is based upon the prices at representative markets published each week in the "Return of Market Prices" (now the "Agricultural Market Report"), shows that during November the general level of prices of agricultural produce in England and Wales was about 84 per cent. higher than in 1911-1913. The decline which has continued almost without interruption since November, 1920, was thus checked to some extent; the prices in the previous month were about 90 per cent. above those ruling in pre-war days, so that the fall indicated by the latest figures is only 6 points, compared with 15 points from September to October. The following table shows the figures for each month since the beginning of 1919:—

Month.	*Increase per cent. on the average of the years 1911-1913.* 1919.	1920.	1921.
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	105
October	166	191	90
November	182	197	84
December	207	194	—

Practically all classes of produce were concerned in the fall in November, the chief exceptions being eggs and milk. The average price of wheat during November was only 45s. per 480 lb. or less than 40 per cent. higher than in 1911-1913, while oats were also less than 40 per cent. dearer than in pre-war days. Fat stock of all descriptions declined considerably in price, although the decline was somewhat less marked than in the previous month. Dairy cows were rather dearer, but store stock showed little alteration in price compared with the previous month, but remained relatively cheaper than fat stock.

Feeding stuffs showed little change in price, milling offals and maize being slightly dearer and oilcakes experiencing a correspondingly slight decline. Fertilisers also were not greatly altered from the previous month, although superphosphate and nitrate of soda were inclined to be easier in value.

THE publication hitherto issued by the Statistical Branch of the Ministry under the title "Weekly Return of Market Prices" will in future be known as the "Agricultural Market Report," and in addition to reports on markets and market prices in England and Wales, will contain information on the export trade in agricultural products from foreign countries and the colonies to the United Kingdom, together with such information as can be obtained as to openings abroad for British farm products.

The Agricultural Market Report.

The desirability of publishing information of this character has been pressed upon the Ministry by the National Farmers' Union, and an endeavour will be made to include original items of information which are likely to be of direct value to the farmer.

The return has hitherto been supplied to the public free, but in view of the increased cost of printing and publishing, it has been decided that after 1st January, 1922, the "Agricultural Market Report" can be supplied only to subscribers. The rate of subscription will be 10s. per annum or 5s. for six months, post free. Single copies 2d. (or by post 3d.). Application should be made to the Secretary, Ministry of Agriculture and Fisheries, Publications Branch, 10, Whitehall Place, S.W.1, or to H.M. Stationery Office, Imperial House, Kingsway, W.C.2.

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THE Ministry has arranged with the authorities of the University College, Reading, to hold a special course of instruction on Milk Recording, from 27th February to 18th March, 1922. Full particulars of the course are shown in the syllabus outlined below.

University Course in Milk Recording.

It is expected that the demand for qualified recorders for employment under the Ministry's milk recording scheme will increase as the scheme develops, and while the appointments of milk recorders—which are not made by the Ministry itself but by milk recording societies—carry with them somewhat limited salaries (usually from about £150 to £250 per annum), such appointments afford the young agriculturist excellent opportunities of gaining a practical knowledge of dairy farming as carried out on a variety of farms. It is impossible to give any indication as to the number of vacancies for milk recorders which may arise from time to time, nor can any guarantee be given

to students at the course that they will, in fact, obtain employment as milk recorders. The Ministry will, however, arrange to bring under the notice of all milk recording societies the names of successful students, with a view to preference being given by such societies to these students over other applicants when any vacancy for appointment arises.

Syllabus of the Course.—Students will travel to Reading on Monday, 27th February, and tuition will begin on the following day. Each day's instruction will include (*a*) at least two hours' theoretical teaching, and (*b*) practical work in weighing, sampling, testing, and the keeping of milk records.

(a) Lecture Course.

1. *Milk.*—Nature and composition ; causes of variation ; Food and Drugs Act ; regulations concerning milk.

   Bacteria.—Milk as a medium for bacteria ; control of bacterial growth ; importance of cleanliness ; use of preservatives.

   Testing.—Weighing ; methods of sampling ; simple and composite samples ; determination of the percentage of fat, and of the specific gravity ; the Gerber Test ; the Lactometer, calculation of percentage of total solids from percentage of fat and specific gravity ; calculation of averages.

2. The principles and practice of milk recording ; the Ministry of Agriculture's scheme ; why accuracy in detail is essential ; discussion of the duties of recorders, with a study of the forms which must be kept ; milk record certificates and register of dairy cows ; interpretation of milk records ; calculation of herd averages ; marking of cows ; calf and bull marking scheme ; methods of keeping food records.

(b) Practical Work.

Actual milk recording ; the taking of simple and composite samples under various conditions ; determination of the percentage of fat (Gerber method) and the specific gravity ; calculation of total solids ; use of the Richmond scale ; visits to farms, evening and morning, to weigh milk and make the necessary entries ; checking records ; detection of errors and abnormal results ; keeping food records and calculating cost of feeding and cost of food per gallon of milk.

At the conclusion of the course the authorities of the University College, Reading, will notify in writing those students who have satisfied their instructors as to their industry and general ability, and who have passed both the theoretical and practical examination held during the closing days.

Tuition Fee and Residence.—The tuition fee for the course will be £3. Board and residence is obtainable in the neighbourhood of the college at rates varying from £1 15s. to £2 5s. per week, and a list of lodgings will be sent to inquirers on application to the Dean of the Faculty of Agriculture, University College, Reading, to whom applications for admittance to the course should be forwarded before 15th February, 1922.

THE NEED FOR LIME AND HOW TO MEET IT.—II.

B. H. BEDELL.

IN an article on this subject in the June issue of this *Journal*, the writer showed in what way the urgent need for more agricultural lime could be met by farmers who were so situated that they could utilise a portable limestone grinding plant. It is now proposed to describe, in the briefest outline, the principal features of larger and permanent limestone-grinding plants, and give some particulars of lime kiln construction, and the process of lime burning.

Permanent Agricultural Limestone Plants.—In cases in which the probable local demand for ground limestone warrants the installation of a fixed plant to be owned by a farmers' co-operative association, or by a company making a business of grinding limestone, it will always be necessary, except when chalk is being dealt with, to elaborate the plant more than was considered expedient in the case of the portable types described in the previous article, and to produce a more finely-ground product. To this end the stone must be broken down to about 1-inch cube before it is passed into the mill for fine grinding.

The lay-out of the plant will therefore be somewhat as follows:—

(*a*) Receiving hopper and chute into which quarry skips tip the rough stone, delivering into—

(*b*) Jaw breaker, reducing stone to 2½-in. cube.

(*c*) Elevator, raising broken stone to—

(*d*) Small breaker, or rolls discharging directly into feed hopper of—

(*e*) Fine-grinding mill from which the stone dust is raised by an elevator into storage bins from which it can b· loaded directly into wagons or bagged through propeily constructed sacking mouths.

In the case of small plants, a second jaw breaker or rolls can frequently be omitted by setting the first breaker to produce material fine enough to feed directly into the fine-grinding mill.

With regard to (*b*) and (*d*) little need be said, since these are quite standard pieces of plant with which every quarry manager is familiar. The fine grinding, however, presents many problems, the answers to which are only now being worked out. There are, broadly speaking, three types of mill which in modern practice are considered in connection with this work.

First, there is the High-Speed Mill in which the stone is ground between steel surfaces somewhat after the principle of a pestle

and mortar. Such mills are represented by "The Griffin," "Bradley" and "Fuller Lehigh." In these, the stone is crushed, percussed and ground, while at the same time, the ground product is being constantly stirred up and thrown against a screen which determines the maximum size of a particle which can pass out of the mill. If an excessively fine product is not demanded, such mills offer a cheap and efficient means of reducing the stone, provided care is used in their selection and types which involve the use of bearings within the grinding chamber are avoided, since it is obviously difficult to exclude dust from them if they are running in the midst of it.

The second type is the Ball Mill, in which the stone is broken by percussion in a chamber in which there are a number of steel balls. The inside of the chamber is lined with steel plates set to form a series of steps upon which the balls fall as the chamber rotates. The outside is encircled by a wire screen. The ground product is continuously subjected to screening, so that only those particles which are still too large to go through the screen are retained in the mill for further reduction This mill produces normally a product very similar to that obtained by the use of the first type described, but owing to the rather more rigorous screening, the proportion of "fines," that is, of material very much finer than the mesh of the screen used, is rather smaller than with the first type. This is not an advantage from the agricultural point of view.

The third type is known as the Short Tube Mill. It consists of a slowly-revolving steel drum, with a slightly inclined axis, in which originally pebbles were used as the grinding medium. The stone is fed in slowly at one end, and finds its way through the drum to the other end as the drum rotates, the rate of feed being adjusted so that by the time the stone reaches the far end of the machine, it is ground by attrition between the pebbles to the required state of subdivision.

The last few years have produced two modifications of this class of mill. In the first place, steel or chilled cast iron balls have, to a large extent, replaced pebbles, and in the second place, a direct air draught through the drum is frequently provided to bring about air separation of the finest dust as it is formed. In this way the output of a given mill can frequently be increased by 15 to 20 per cent. while scarcely interfering with the quality of the product. Unless the fine dust is removed in this way it continues to be dragged round until it finds its

way out with the bulk of the material, thus taking up valuable space which might be better occupied by stone particles still requiring reduction. Mills of this type can be employed when a very fine product is aimed at, such as would leave 5 per cent. residue on a 60 screen or finer.

A grinding plant to deliver 50 tons of ground stone a day, and consisting of machines similar to those described, would require approximately 100 h.p. to operate it, and the actual quarry and mill costs involved in producing the ground material should not amount to more than about 8s. per ton. To this must be added sums representing overhead charges, including interest on capital and maintenance of plant.

The qualities of stone suitable for agricultural purposes, the degree of fineness of grinding, the chemical composition, etc., have all been dealt with in the previous article, to which reference should be made. Following this brief sketch of the means available for increasing the supplies of ground limestone, an outline may now be given of the plant and processes used in preparing quicklime, devoting particular attention to kilns and methods most likely to be of service to agriculturists who recognise the necessity of cheap lime, and are prepared to take the necessary steps to burn it for themselves.

Lime Burning.—The very ancient craft of lime burning consists in heating any fairly pure limestone or chalk ($CaCO_3$) to a temperature high enough to drive off the carbonic acid gas (CO_2), which is combined with it, leaving behind the lime or calcium oxide (CaO). It is one of the very simplest of commercial chemical processes, but it is not, for all that, one which can be uniformly carried out without both theoretical knowledge and experience.

Before describing some of the types of kiln in which the burning is done, it will be well to look at the theoretical considerations which are involved. Carbon dioxide begins to be driven off from limestone at a temperature of about 600° C., but it is necessary to raise the temperature to somewhere between 900° C. and 1,200° C. in order to make sure that the burning is complete. Even so, it is necessary that the stone should remain at this temperature for an appreciable time, and not simply be hurried through the hottest part of the kiln. The effect of either too low a temperature, or a too rapid passage through the reaction zone (as that part of the kiln is called where the highest temperature is attained), is the production of lime in which there is a large amount of "core," composed of

the centre parts of the larger pieces of limestone which have not given up the whole of their carbon dioxide. Although it is necessary to raise the stone to a high temperature in order to complete the reaction, it is not always safe to reach the upper limit given, for too much heat opens the door to several different kinds of trouble. In the first place, a stone which contains any appreciable percentage of impurities, such as silica, alumina or iron, will be found partially to fuse and to combine with the impurities in such a way that it is very slow to slake, and, even if it will slake, may be very granular and insoluble. Moreover, even a pure calcium carbonate stone if over-burnt will yield a granular hydrate, which is much less satisfactory than the impalpable powder formed when water in the correct proportions is added to a well-burnt stone. It is an interesting fact that, owing to the combination between the magnesium and calcium carbonates in a dolomite breaking up below the temperature at which the carbon dioxide is given off, the resulting hydrate is often of the very finest grain, provided of course, that the dolomite is free from fusible impurities.

Amount of Heat required.—Despite the claims of phenomenal efficiency put forward by the proprietors of special types of kiln, there is a certain minimum amount of heat which must necessarily be supplied to burn a given weight of lime, and below this minimum it is utterly impossible to go, no matter how wonderfully efficient the special kiln recommended may be. In the first place, there is the heat required to drive off the carbon dioxide from the stone; this amount is exactly known, and amounts to 3,255,000 British Thermal Units (B Th.U.) per ton of lime, and represents the burning of about 2 cwt. of good average coal. This factor is unalterable by skill in kiln design, or care in operation. Secondly, there is a certain amount of heat required to drive off any moisture which may be present in the charge and to heat it up to the temperature at which the reaction takes place. It is true that some of this heat (but never as much as 50 per cent.) may be recoverable from the burnt lime as it is cooled in the lower part of the kiln. Next, some heat is needed to warm the air used for combustion of the fuel to the temperature of the reaction zone. Some of this is supplied by the heat in the cooling lime, but some also has to be provided by the fuel itself, and although in the upper part of the kiln a fair proportion of this heat may be recovered in warming the stone before it reaches the reaction zone, much heat always escapes with the gases from the top of the kiln.

Lastly, there are the heat losses due to convection and to radiation from the outside surface of the kiln, which can be minimised by thick walls containing non-conducting layers, but must always represent a very material fraction of the fuel bill.

When all these things are taken into account it is found that, in a well-designed kiln, it is not possible to produce a ton of lime with less than about 3½ cwt. of coal, and it would be safe to say that the majority of kilns in England are using nearly double this amount.

When making lime from chalk, the amount of moisture commonly present in the chalk is so great that the necessity for its evaporation has an appreciable effect upon the amount of coal burned. An additional ¾ cwt. of coal per ton of lime produced is the calculated amount required for this purpose in the case of a normally damp chalk.

Types of Kilns.—There are innumerable designs of kilns, which have been more or less successfully used since the earliest system of burning lime in open clamps (not yet quite abandoned in this country) gave place to more economical methods. They range from tiny pot kilns, containing only two or three tons of lime, to enormous shaft kilns with a daily output of a hundred tons.

Pot Kilns.—In the small pot kilns, which have a more or less egg-shaped interior, the limestone and the fuel are put in in alternate layers. The first layer of limestone is laid (domed if there are no iron bars supporting the charge) on top of a thick layer of fuel supported on the kindling. When the kiln is full the fire is started and allowed to burn itself out. This method is very wasteful of fuel, but where only a small quantity of lime is needed, it is often the cheapest way of producing it at the spot where it is required. The chief difficulty that will be encountered in attempting to revive this simple practice is in obtaining the services of a lime burner who has enough experience to be able to superintend the process. Little kilns of this type are usually built of limestone or some other local stone and are not lined with fire-brick. The surface of the stone usually spalls off, particularly at first, but a more or less refractory slag then forms and seems to act as a preservative for the deeper layers of the stone. The somewhat ruinous remains of kilns of this type can be seen in almost all parts of our countryside.

One source of loss in these kilns is the fact that the kiln, as

well as the stone to be burned, has to be heated afresh for each charge. Despite this defect, there are much larger intermittent kilns of more elaborate design, which are occasionally used for burning special limes, although it is doubtful whether their use can ever be justified for agricultural lime, whatever their merits may be when used for hydraulic.

Draw Kilns.—The type of kiln in which the agriculturist is most likely to be interested is the shaft or draw-kiln. Here the process is continuous, not necessarily in the sense that the kiln is worked night and day, but continuous in the sense that the fire is only drawn when repairs are needed. Kilns of this type are frequently more than 50 feet in height, and should never be less than 15 feet, and even at this, the efficiency is not likely to be very high. The kiln is circular in plan and usually slightly bottle-shaped, and considerably smaller at the draw eye at the bottom than it is a little higher up where the greatest heat is developed. It is always lined with 9 in. or more of fire brick.

The principle upon which these kilns are worked is that, once the kiln is started, alternate layers of limestone and fuel are put in at the top in proportion as cooled burned lime is drawn at intervals from the bottom. As this is done the contents of the kiln slip down and a re-distribution and mixing of stone and fuel takes place. Each successive layer of fuel burns evenly and regularly as the flame and hot combustion gases from the lower layers reach up to it. It will be readily understood that in order to attain the maximum thermal efficiency it is necessary that the bed of burned lime below the reaction zone should be deep enough to enable the air entering the eye of the kiln to take up most of its heat before it is "drawn." In this way the air which reaches the fire is well warmed (on the regenerative principle) before it enters the "reaction zone," which is anything from 5 to 15 feet in depth, depending on the size of kiln and rate of working. Above this zone there should be room for a deep bed of mixed fuel and stone, through which the hot gases pass before they leave the kiln. In their passage they impart to it a large proportion of the heat which they carry, with the result that the stone is well heated before the actual burning takes place.

Coal producing much gas is liable to lose an important part of its calorific value during its passage with the stone through this pre-heating section of the kiln. If this defect be disregarded there is probably no type of kiln better calculated to

give a maximum yield of lime per ton of fuel burned. In order to avoid this loss and to obtain certain other advantages in the way of more direct control over the temperature, many kilns have been built, in which by one means or another, the stone is pre-heated by the waste gases before the fuel is mixed with it.

Ring-Fired Kilns.—One of the most thermally efficient, and perhaps most effective ways of pre-heating the stone alone, consists in building a kiln in such a way that the pre-heating section is of pronouncedly smaller diameter than the reaction zone, the step in size being made as sudden as possible, with the result that the stone, as it descends from the small part into the larger, leaves a considerable space between itself and the increased diameter of the kiln wall, into which it is possible to introduce the fuel, as required, by means of sloping passages in the kiln wall, fitted with fire doors. The re-distribution of the lime blocks, as they tumble down from above is relied upon to produce a sufficiently even mixture of stone and fuel. The distribution is, however, not usually as uniform in such kilns as when the coal and lime are fed together into the top of the kiln. There is therefore a definite limit to the ratio, diameter to depth of the reaction zone in kilns of this type.

In the case of each kiln so far described, the product as it comes through the eye is a mixture of lime and ashes. When the lime is exclusively for agricultural use, there is little disadvantage in this, and in any case a separation of the small lime and ashes can always be effected by handling it with forks when loading.

Separate Furnace Kilns.—In this kiln the lime is delivered in a purer condition than in the kilns described above, and is quite free from ash. This is accomplished by arranging that the fuel itself never comes in contact with the stone. It is burnt in furnaces built in the kiln wall, but out of the line of direct descent of the stone. By this means the gases from the furnaces containing the whole of the heat generated by the fuel (except a small proportion lost by radiation from the furnace crown and walls) enter the kiln through aperatures in the side at the bottom of the "reaction zone"; here they mingle with the stone and pass up through the kiln, pre-heating the descending charge in the ordinary way. The regenerative principle can only be applied, however, if fans are used to draw the air for the furnace through the cooling lime. This system has the advantage that any type of fuel which may be available in the district can be used, and the

control of the process, from the temperature point of view, is very complete. Such a kiln can have the fires banked and be shut down at night with very small loss, and can be started up again in the morning, which advantage is not usually shared by the gas-fired kilns, next described.

Gas-Fired Kilns.—The cleanliness and ease of temperature control which are associated with kilns fired with producer gas, have rendered them very popular in the case of large lime plants, although it is questionable whether even in these cases the thermal efficiency can be as high as in the best types of coal-fired kilns. It is clear that the radiation losses from the gas producers must be an additional net dead loss in comparison with kilns in which the whole thermal process is confined within the kiln walls. The restriction of the ratio, diameter ÷ depth of the reaction zone, is even more limited in the case of these and the separate furnace kilns than with ring-fired kilns above referred to; otherwise the system is, in many ways, ideal. The lime produced is particularly free from any combination with combustion products from the fuel, and is of course without any ash. Since this system of firing is not likely to be adopted by small agricultural lime works, it is not proposed to dwell further upon its merits or demerits.

The Hoffmann and Rotary Kilns.—Two other types of kilns occasionally used for the production of agricultural lime should be mentioned, although in neither case are they to be recommended for small installations. The first of these is the Hoffmann Kiln, in which selected blocks of limestone are carefully stacked in such a way that passages are left for combustion gases and fuel in a series of chambers built in a ring. By a rather complicated arrangement of dampers, the various compartments of the kiln are brought into operation in sequence. Air is drawn through chambers in which the lime, still hot from being burnt, gives up its heat to it before passing into the chamber corresponding to the reaction zone, and the combustion gases pass on from this through chambers where the limestone is being pre-heated. Fuel is fed through openings in the tops of the chambers. The system produces excellent lime, but the labour of stacking the stone and the large radiation losses render the production of cheap agricultural lime impossible.

The Rotary Kiln is the last to be described. It is like a cement kiln in principle and construction. Small limestone from 1½ in. down, is fed into the end of a long, rotating

steel drum lined with fire-brick, and in its passage is burnt to lime in contact with the flame produced at the opposite end of the kiln by means either of powdered coal or producer gas. The thermal efficiency is not very good and the upkeep is high. Such kilns are only useful to large quarry installations, where the small stone is a by-product, and unless converted into lime in this way, would be unsaleable.

Practical Kiln Construction.—Pot or shaft kilns can often be built so that natural support for three sides can be obtained by setting the kilns in a recess excavated in a cliff or bank; the front then remains the only structural part requiring special care. The charge exercises a bursting pressure much as water would do, and in tall shaft kilns great care must be taken that the front (usually flat on the outside) is well held up either by buttresses or by anchor ties connected by steel joists and well fixed in the rock at the back ends. Kilns which are without natural support are best finished circular and either held in by stout steel straps at frequent intervals or preferably encased in a ferro-concrete shell.

Kilns for heavy and continuous duty should be lined with fire lumps 12 in. or 15 in. from front to back and, say, 6 in. deep in the courses over the area of the reaction zone; otherwise ordinary fire brick laid in courses of headers will be found suitable. An ordinary brick backing should come next to this and then an expansion joint, say ¾ in. to 1 in. wide extending all round and for the whole height of the kiln, should follow.

The joint is best filled with carefully selected and completely burned clinker screened through ½ in. mesh and rejected on ¼ in. mesh screen. This joint is useful in that it allows the inevitable expansion and contraction of the lining to take place without cracking the external shell, and also presents a very useful check to the conduction of heat from the lining wall outwards. Between the bricks surrounding the expansion joint and the external supporting shell (be it of reinforced concrete, stone, or brick), there is a space of variable thickness and section which must be filled, since thick walls are needed to keep the heat in, but the substance used is largely a matter of indifference, and in the writer's experience has ranged from good brick and masonry down through sun-dried clay lumps to quarry waste tipped in, without having any observable effect on the utility of the kiln.

Most draw kilns are open topped, but some have hoods, and some have a steel or other light shaft erected above

the hood. Hoods are apt to prove dangerous to the men charging the kiln by reason of the gases which collect in them, and unless the situation of the kiln is ill chosen with reference to the prevailing winds, hoods are best avoided.

The taller the kiln the better it is for draught, regenerative, and pre-heating efficiency, but there are two important limitations—(1) great height without proportionate increase in diameter so increases the radiating surface per unit capacity of kiln that the heat losses begin to increase, and (2) height must be proportioned to the resistance which the particular stone offers to crushing both before and after it is burnt. This consideraion, if neglected, may lead to so much breaking up and packing of the charge that the draught is destroyed.

It is possible to burn a fairly crushable stone, such as oolite or chalk, in a tall kiln if either of the following devices are resorted to:—(*a*) The kiln lining may be made elliptical in plan in such a way that the major axis shrinks and the minor expands until they have changed places as it descends the kiln; (*b*) A pair of obstructing rounded shoulders may be formed in the lining so that the charge descends by a slightly zig-zag motion. By the use of either (*a*) or (*b*) much of the weight of the charge is taken upon the kiln walls rather than upon the lime in, or below, the reaction zone, and crushing is thereby minimised.

Single and therefore unsymmetrical draw eyes are objectionable, particularly in short kilns, because they cause uneven draught and descent of the charge. An arched circular passage entered from the front and built in the thickness of the wall at the base of the kiln has been successfully employed to enable four draw eyes to be conveniently worked in each of a battery of kilns with access to the front only. The size of the stone composing the charge may increase with the size of kiln. In a big kiln it is possible to burn thoroughly large blocks of stone which would leave a large residue of core if calcined in a small kiln. The more nearly the blocks are cubical (not flakes) and the more uniform they are in size the better will be the draught; a lot of small stuff in the charge fills the voids and makes a good draught impossible. The fuels which can be used in shaft kilns are limited to anthracite (small anthracite or "culm" is usually employed), hard steam coal, and gas coke.

Treatment of the Lime.—Now that lime is so comparatively expensive a product it is no longer reasonable to distribute it in lumps over the land and leave time and the weather to effect an even distribution, which, it may be added to their discredit, they never did accomplish. Something must always be done

to get the lime into a fine enough condition to apply with a distributor. It may be ground (in a disintegrator),* or slaked to form the hydrate $Ca(OH)_2$. There is only one method known to the writer by which lime may be ground without making so much dust that the tending of the plant is almost beyond human endurance, and that one method consists in mounting the disintegrator on the top of a large air- and dust-tight storage bin (with sacking mouths at the bottom always sealed by ground lime). A wooden or sheet metal tube is led from the top of the bin into the feed mouth of the disintegrator. This tube suffices to return the dust-laden air, which is circulated by the fanning action of the disintegrator, to the machine again, and no air escapes to carry with it irritating lime dust. This arrangement obviates settling chambers, dust, balloons, etc., with all their inefficiency and expensive upkeep.

If it is decided to produce the hydrate, there is no necessity for a small concern to invest in any of the numerous hydrators. The essential thing is that water should be added in the right quantity and the right way to the lime when it is freshly burnt. The quantity of water needed is a hundred gallons per ton of quicklime. Theory requires that only 72 gallons should be added, but it is necessary in practice to allow for the water lost in steam, which is given off when the lime and water have been in contact for a short time. A good deal of evaporation also occurs during the mixing.

Many different methods of adding the water to the lime have been advocated, but if the correct proportion of water is strictly adhered to and an even distribution, followed by a thorough mixing, is secured, it matters little what the exact procedure may be. After mixing, the lime should be left undisturbed for 24 hours to allow the reaction to complete itself. Then, if the product is to be applied by means of a distributer, it must be screened through a ¼ in. or even finer screen to remove core, ash, flints, etc.

Lime hydrated in this way is an excessively fine, dry powder and can be safely stored in bags, as it will not swell like ground quicklime and burst the bags. It only takes up carbon dioxide from the air very slowly; not more than about 4 per cent. is found to be converted to the carbonate after exposure to the air in bags for a whole year. It therefore almost ranks with ground limestone so far as its convenience in handling and its

* For description of these machines see the June issue of the *Journal* (p. 204).

keeping qualities are concerned. It has an advantage over the former in that three-quarters of a ton of hydrated lime is chemically equivalent to a ton of ground limestone. One ton of pure burnt lime becomes 26½ cwt. when it is hydrated, and it will therefore be seen that there is no reason why the farmer should pay fancy prices for the hydrate, which he can quite easily prepare himself from lump lime, or alternatively, why he should trouble to obtain ground lime, which not infrequently is largely composed of ground-up "core" (carbonate), ashes and air-slaked "small lime," and for which he is usually charged at least 5s. a ton above the price of good lump lime.

SUFFOLK SHEEP.

S. R. SHERWOOD.

THAT which first attracts one in the Suffolk sheep is its thoroughbred appearance. The head, the legs below the knee and hocks are bare of wool and covered with fine, jet-black, glossy (not mossy) hair. The face is long, with a fine muzzle, especially in the ewe—indicative of a good breeder and milker. The eye is bright and full, the ears are thin, silky and alert, not drooping. When in full fleece the sheep bears a wealth of fine, dense wool, not shading off into dark wool or hair but clearly defined from the black head and legs and noted for its pure whiteness, fineness, elasticity and strength. The whole carriage is alert, showing stamina and quality. Indicative of the latter is the fine but strong, flat, clean bone of the leg. The skin is fine, soft and pink.

History and Progress.—The breed originated by the mating of the native horned ewes of Norfolk with Southdown rams. This is recorded by Arthur Young in his *General View of the Agriculture of the County of Suffolk* published in 1797; and the famous Coke of Norfolk was one who made the experiment. The resulting cross was immediately recognised as a fine butcher's sheep and soon became popular in East Anglia. By process of further crossing and selection a fixed type was evolved, and the Suffolk has been recognised as a pure breed since 1810. In 1886 all interests were united by the formation of the Suffolk Sheep Society and systematic keeping of records, and the breed quickly made its mark among the other breeds of Great Britain.

The annual carcass competitions of the London Smithfield Club are the supreme test of the meat-producing value of the various British breeds, and the results are of world-wide importance. The primary aim of the Club is " To encourage the selection and breeding of the best and most useful animals for the production of meat and to test their capabilities in respect to early maturity." At that Show in 1890 the first prize Suffolk wethers showed the highest percentage of carcass to gross live weight of any breed, and from that time onwards the breed has made steady and uninterrupted progress and has a record of successes in those competitions as mutton producers which to-day place it ahead of all other British breeds. Since the commencement of the competitions Suffolks and Suffolk crosses have won half the championships and reserves for championship; Suffolk lambs have, since 1900, won two-thirds of all the prizes in the short-wool lamb class; and Suffolks crossed with no less than ten different breeds have won half the total awards in the crossbred classes.

Factors in Improvement.—One of the first steps taken to bring about the improvement of the breed, and at that time a unique one, was the institution of flock competitions. Breeding flocks compete for challenge cups according to their size. The Bristol champion challenge cup is awarded each year for the best flock in the competition and another cup for the best ewe lambs. All flocks are inspected prior to first registration and every fourth year subsequently. This has done a very great deal to raise and maintain the general standard. No sheep is recognised as a purebred Suffolk unless it has the Society's registered mark and registered flock number of breeder tattooed in the left ear.

Popularity.—From the first the Suffolk has given evidence of its value as a good coloniser. As early as 1895, rams, lambs and ewes bred in France won first and special prizes at the Boulogne Agricultural Society's Show in open competition with other breeds. Reports from Canada and North America, Australasia, Chile, Peru, Brazil, South Africa and other places all testify to the remarkable way in which this breed adapts itself to its environment. Its adaptability to varying soils and climates—due to its inherent hardiness—is exemplified in the way it has spread over the whole of the British Isles, there being to-day registered flocks in no less than fifty-four counties. The Society's show and sale record points to the lively interest exhibited in these sheep all over the country; not only at the

Royal, the Highland, the Royal Ulster, Royal Dublin and leading County shows is this breed strongly represented, but in competition with other breeds at smaller shows and sales all over the country the Suffolk holds its own and its excellence for crossing purposes is evidenced.

The high level of prices for the general run of Suffolk sheep is probably unexcelled by any other breed. At the four principal lamb sales in 1920, 6,013 ewe lambs averaged £5 18s. 4d. with a top price of £40 per head for twenty. The 5,723 two-tooth ewes sold at the three principal ewe sales averaged £10 6s. 9d. with a top price of £61 per head for ten, while 1,800 older ewes averaged from £8 to £14. At the five principal sales of ram lambs, 1,255 averaged £22 9s. 6d. with a top price of £399. In 1921 Suffolks shared with all breeds in the general drop in values, but the keenness of the interest is unabated and new flocks are continually being established.

The following facts are indicative of the way the Suffolk has been taken up by Scottish breeders and graziers. Ten years ago one solitary registered flock held the field in the North; to-day, from Yorkshire northwards to the Cromarty-Firth, there are nearly 40 registered flocks and every promise of extension. Scotsmen are among the principal buyers at the Society's sales, in 1919 taking ram lambs at 135, 200 and 390 guineas, and in 1920 at 105, 150, 190, 200, 210 and 250 guineas. That these prices have not been given in vain is proved by the success of Scottish flocks in show and sale yard. The exhibit of Suffolk sheep at the Highland Society's Show is one of high merit, while those who have ventured to send South to the Royal and Smithfield Shows have taken high positions. At the Kelso ram sales in 1920, 361 Suffolk ram lambs, mostly bred in Scotland, averaged £22 16s. 7d. with a top price of £170. One-quarter of the whole of the awards won by Suffolk crosses at Smithfield have been won by Suffolk-Cheviot crosses from the North, while from August onwards Suffolk crosses frequently top the northern lamb sales. Suffolks and Suffolk crosses have won the championship eight times and reserve for championship seven times at the Scottish National Fat Stock Show. In 1919 Suffolks and Suffolk crosses were champions at Smithfield, Edinburgh and York. In Ireland the breed also does well: there are to-day registered flocks in 13 counties, and though they do not realise such high prices as in Great Britain they might do so if breeders brought them out in as good a condition and in show form. A few recognise

FIG 1. Suffolk Ewe Tegs, 17 months old, in full Flee

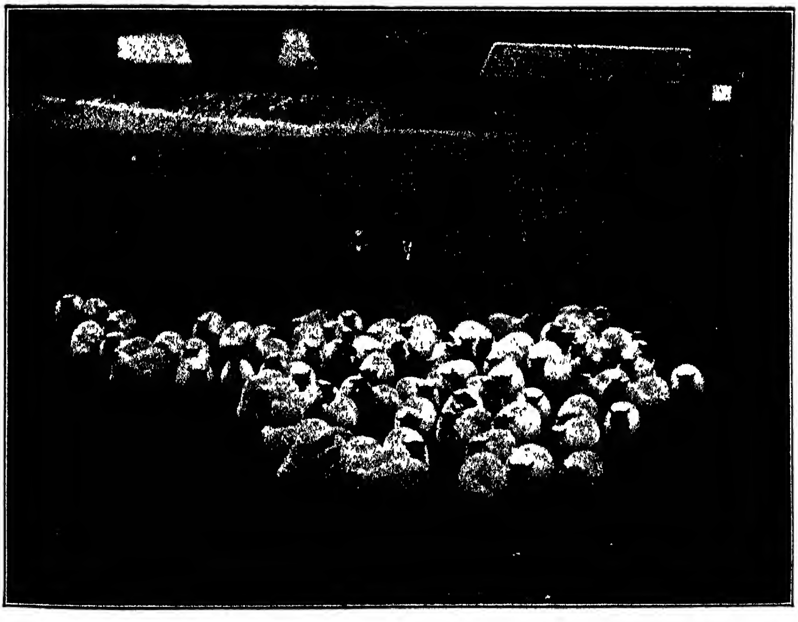

FIG. 2.—Suffolk Ewe Tegs, 17 months old.

the necessity of doing this and reap the reward—both as a good advertisement and also in prize money and sales—but as a rule they are not " done " well enough.

It is reasonable to believe that the Suffolk would not have spread as it has done nor won such success in competition with other breeds were it not for the combination of fine qualities it possesses. Its hardiness is proved by its success as a coloniser. In point of early maturity, well-grazed hoggets, under usual farming conditions, at the age of 8 to 10 months yield 78 to 84 lb. of dressed carcass, and the leading position maintained in the Smithfield carcass tests as above detailed is proof positive of it. The fecundity of the Suffolk, due to its Norfolk ancestry, is proverbial. As a New South Wales breeder well puts it:

> "The beauty of this breed (I am referring to its bank account beauty) is that it produces both quantity and quality. My experience has been that single lambs are unusual, twins usual and triplets not uncommon."

The average for all registered flocks for 33 years is 133.01 per cent. of lambs reared.

Wool.—The fleece as described above spins 56's in Bradford counts. Mr. W. T. Ritch, Technical Instructor, American Wool Improvement Association, writing on January 15th, 1921, says:

> "Your samples of Suffolk wool, both ewe and hogget, are the best types of medium Down wools which I have tested during the past ten years, either in Australasia, South Africa, South America, Canada or the United States. The length is good, the character excellent and the density is wonderful, while the colour, strength and elasticity leave nothing to be desired in Down wool."

Writing again on February 14th after testing the second prize fleece at the Darlington Royal Show, he says:

> "The crimp and lustre is good enough to satisfy the most fastidious judge of Down wool."

Mr. J. Thomson Stephen, wool expert, Leicester, writing in the *Mark Lane Express*, December 1st, 1919, said:

> "The various crosses of Suffolk sheep yield fleeces of grand character. Suffolk rams are very impressive in imparting their characteristic, to the wool of the sheep with which they are crossed. During the wool sales, where fine wools of the highest character in the kingdom are shown, a very large proportion were half-breds by Suffolk rams. I made a very careful inspection of these half-bred Suffolk lots, and in every instance they commanded the top prices of the day. They produce yarns of what is known as 57 to 58 counts, and these are the very qualities most in favour for all the finest grades of sound and durable hosiery fabrics."

In the opinion of Mr. S. B. Hollings, a Bradford wool expert:

> "A Suffolk fleece possesses exceedingly good, sound commercial characteristics. The quality is good 56's, the staple is nice length, sound and altogether ideal for hosiery purposes. So long as such fleeces are grown there will always be a healthy market, for wool of this character is more appreciated to-day than ever."

The average yield of Suffolk wool (washed) is for flock ewes from $5\frac{1}{2}$ lb. to 6 lb., and for shearling ewes first clip 7 lb. per head. The fleeces of sheep that are extra well done will weigh slightly more. It is among the top price wools in Great Britain to-day.

Management.—All the leading flock-masters retain the best ewe lambs of their own breeding, in most cases keeping considerably more than they require, for selection to make up the flock the following year, as it is impossible to tell for certain until then which will grow into the best sheep. The flock is made up a few weeks before mating, which in ram breeding flocks commences August 7th. The whole flock is carefully examined, all defective ewes being drafted, such as those with bad udders, delicate constitutions, unsatisfactory breeders, old and broken mouthed, etc. To facilitate this, ewes are sometimes earmarked as defective when in the lambing pen, as faults may be noticed then that might be overlooked at time of drafting. The shearling ewes are then very carefully examined to ensure that the very best are selected for making up the flock to the required number. Every year the utmost care should be taken to ensure that the flock is in a sound and healthy condition, and the ewes of as good a type and character as possible. If this is not done every year the flock will be sure to deteriorate.

The greatest care is taken in the selection of the rams. Good home-bred rams may be, and often are, used. There is much to be said in favour of this, as one knows exactly how they are bred. If and when outside blood is necessary every effort is made to secure the best without too great a consideration as to price. Ram lambs are chiefly used, but when one has proved a good sire it is used for several years.

It is advisable that the ewes should mate quickly to get a uniform lot of lambs born as early in the year as possible. The best of these are pushed on for exhibition at the shows and all the ram lambs kept going until the sales, the competition being very keen. The best of the ram lambs will weigh from 10 to

12 stone by 1st June. To ensure quick mating it is best that the ewes should not be in too high a condition. About a week before the rams are turned in the ewes should be put on good feed, nice aftermath grass or cattle-fed pasture or any fresh ground available, such as stubbles, with a fold of rape or thousand-headed kale.

It is found very beneficial if the flock can get an entire change for a short time on a farm that has been free from sheep for some time. If good, sound marshes are available that have not been sheep fed during the spring and early summer, flocks may be sent there to great advantage during the late summer and autumn, but many flock-masters have not this opportunity. About November the principal food is white turnips, with a run on stubbles, grass or heath land. A month before lambing a little trough food is given, about ½ lb. per head of crushed oats, linseed cake and bran or malt culms mixed, to bring the ewes to the lambing pen with a plentiful supply of milk.

Some farmers have a permanent lambing yard, but it is preferable to have a fresh site yearly and as near the feed as possible. This is formed by standing two or three corn stacks on the selected site, pitching the straw to form shelter from the north and east winds. The yard is then built round this, separate pens being made for the ewes to come in as they lamb. Care is taken to see that the lambs are well mothered before turning out. When feeding white turnips before lambing, especially if it be a mild winter, the ewes should not be allowed too many; they should have a liberal allowance of hay or chaff, and if the turnips should have a disposition to run, that is, the tops shoot up, they should be horse hoed three or four days before folding to cut the tap root. During January, February and March the chief foods are white turnips, cabbage or kale, with a run out on grass, rye or early rye grasses, and if not too frosty a few mangolds thrown out. As soon as strong enough the lambs run forward through creeps, getting the pick of the food. Lamb troughs are kept in the forward fold and a little mixed trough food given, consisting of crushed linseed cake, oats and bran; if good clover hay can be spared this should be given in addition, either long or chaffed. By April there should be a plentiful supply of kale, cabbage, rape and rye grass, etc. When the lambs are young the ewes are kept generously, having 1 lb. per head daily of trough food, to keep up a good supply of milk. This is decreased as the lambs get strong and take a good supply of dry food on their own. In

May mixed clover and grasses begin to make headway. Early trifolium, rye grasses, etc., should be ready; a good store of mangolds must always be available and is an absolute necessity if the spring should prove a late one. The chief food for folding in June, July and August is tares. This should be drilled soon after harvest with a few beans or oats and a succession provided during the summer months, always with plenty of cabbage and mangolds—mangolds if possible—to last well in August. Nothing gives a better bloom to the lambs than white clover or sainfoin, but in some parts of East Anglia this latter does not flourish owing to lack of lime in the soil. August, which is usually a difficult time, must be thought of months ahead, and nothing is a more certain crop at this time than thousand-headed kale. Rape and cabbage may also be provided.

I consider late summer and September the most trying time for flock-masters; flies are insistent enemies even when sheep are carefully dipped. Lambs that are forced for sale are also apt to get feverish, breaking out with sore mouths and heads. This gives the flies their opportunity. Extreme care and attention is then necessary on the part of the shepherd, and frequently an entire change of feed is advisable. I should like to say that in many cases the ewes are docked far too short. The tail should always be left long enough to cover up and protect the parts. If this is not done and the sheep is at all feverish it again gives the fly a special opportunity, and irritation is set up causing great suffering to the ewe. Short docking should cease.

Non-ram-breeding flocks do not commence lambing until the end of February and March, and are treated in much the same way, but one does not go to the same heavy expense.

In conclusion, the management of a flock requires constant care and supervision. Much forethought must be exercised for the proper provision of food. No breed is likely to pay better than the Suffolk, which is very prolific, while none matures more quickly, and few breeds produce such good quality mutton.

BERKSHIRE PIGS.

SANDERS SPENCER.

It would appear to be probable that the breeders of Berkshire pigs would be able to make good their claim that there has existed a so-called Berkshire breed of pigs for a longer period than of any other of the present-day breeds, since pigs called Berkshires were exhibited at the Royal Agricultural Society's Shows nearly seventy years ago. It may be true that there was not a separate class for pigs of the Berkshire breed in the prize schedule, nor was there a class for any other special breed, since the classification is said to have been for white pigs and for coloured pigs.

From the illustrations published at the time, the Berkshire pigs which were successful at the earlier shows of the Royal Agricultural Society were of a black, red and white spotted colour. So far as one can form a judgment from the idealised sketches, the Berkshire of that period varied in form quite as much as in colour from the pig of that breed of to-day, as it was represented as long in the face, with prick ears, long body with good hams, rather high on leg and an infinitesimally small amount of bone. This length of body and lightness of head and offal were together most probably the chief causes for the great popularity of the Berkshire pig with the bacon curers in both England and Ireland about half a century since. The importation of Berkshire boars into the latter country by those interested in the bacon curing industry is said to have immensely improved the form of the native Irish pig and to have vastly increased the proportion of lean to fat in its carcass. This most estimable and valuable quality of cutting a large proportion of lean to fat meat is still retained to its full extent in the present-day Berkshire pig. Of this, abundant evidence is yearly afforded in the carcass classes at the Show of the Smithfield Club held annually in December at the Royal Agricultural Hall, where year after year the Berkshire exhibits have won the champion prizes in competition with nearly all the other breeds and crosses of pigs. Not only do we find evidence of the grand fleshing qualities of the Berkshire pig in the carcass section of this Show, but its success has been nearly as great in the live stock section, as most frequently the championships have been won by Berkshire pigs or by pigs of a first cross or those containing a larger or smaller proportion

of Berkshire blood. It has also been claimed that the suitability of Berkshire pigs for the manufacture of the class of bacon most in demand was one of the chief causes of the establishment of the large bacon factories which have existed for so long a time in Wiltshire and the adjoining counties. It is quite possible that the form and quality of the pigs of the district may have had some considerable amount of influence on the success of the bacon manufacturing industry, but it is equally possible that the fine quality of the pork and the large proportion of its lean to fat meat, due to the consumption by the pigs of the extremely large quantity of dairy offals available, may have had an almost equal amount of influence. At the present time nearly all the best bacon produced in these islands is from pigs kept in districts in which dairying and cheese-making are carried on to a large extent. The same remark applies to imported bacon, as the best of this is said to be produced in Denmark, Canada and Holland—in all these countries the dairying interest is specially noticeable.

This great popularity of the Berkshire pig appears to have led to its temporary undoing. It became fashionable amongst those men who had amassed fortunes in the United States and who in the seventies of the last century expended such large sums in the purchase of shorthorn cattle of the Bates and the Booth tribes. At the time named the breeding of pedigree shorthorns was largely in the hands of men of means and with somewhat large establishments where home curing of bacon was carried on and where the Berkshire pig had become a favourite owing to the high quality of the bacon produced from its carcass, particularly when the pigs had been fed on the dairy offals which were always more or less available in the large country houses. What more natural for the breeder of shorthorns when trading with an American to give a Berkshire pig or even two as a " luck penny " on having made a most profitable deal. Further, there is no denying the fact that a well-made Berkshire moves and looks the gentleman of the porcine breeds.

Unfortunately for the breed many of the imported Berkshires became the property of Americans who possessed a larger amount of money than of knowledge of the practical points of a pig. They were in fact mere fanciers who had taken up the breeding and exhibition of stock as a hobby or with a view to securing a certain amount of notice and popularity. The power to possess something dissimilar to the possessions of other people

also may have had a considerable amount of influence. This must have been the case or the attempt to transform the useful Berkshire into a short-headed, heavy-shouldered, short-backed pug of a pig would never have been attempted. This action on the part of the American fanciers might not have had so disastrous an effect on the breed had not the demand for this "improved" type of Berkshire extended to this country and had not our breeders of Berkshires been tempted by the extravagant prices offered for the type of pig made fashionable in the United States. It must not be forgotten that the farmers and many landlords were at that time passing through a period of great depression; all kinds of farm produce had become greatly reduced in value, whilst the seasons had proved of a most unfavourable character, so that the most up-to-date and so-called high farmers had suffered big losses and were thus easily tempted to spoil the Berkshire pig in order to become possessed of a greater number of American dollars. Fortunately, this craze for the small black type of Berkshire pigs did not continue for any length of time, but much harm was done and the popularity of the Berkshire was temporarily affected. The fancy for the diminutive Berkshire was like most other fancies—short lived.

The great improvement which had been made in one or two other breeds of pigs and the loss of trade together served as a stimulus to breeders of Berkshire pigs to regain for their favourites the leading position which they had lost. The short head, the heavy jowl, the wide shoulders and short backs were viewed suspiciously, since these special points had lost favour in the States and at the same time rendered their possessors of less value on the meat market. The change from the mere fancy to the utility type of Berkshire was so promptly and thoroughly carried out that pigs of the breed are now looked upon by purveyors of pork as quite the equals of pigs of any other breed. There is no doubt that the Berkshire carries a large proportion of lean to fat meat; it matures early in life so that it is suitable for the London porker trade which requires a carcass weighing from 60 to 70 lb., or for those markets in which fat pigs up to a weight of 200 lb. are required; the meat is of fine quality, the skin is fine and the offals are light. Thus the Berkshire is a profitable pig to kill. (Photos face p. 890.)

There is still one point which needs somewhat more attention from the breeders of Berkshire pigs than it appears to have received. This is the milking properties of the sows. The

quantity or the quality—we think it is the former—which some of the sows furnish is not sufficient to rear in the best possible manner a litter of ten pigs. Far too frequently the young pigs do not make the same amount of growth which pigs of some other breeds make ere they are three or four weeks old. This shortage of milk is also most probably the cause of that unevenness in size and development which is too often noticeable in a litter of Berkshire pigs. A complaint is also made by those who make a practice of selling their pigs as weanlings that they are too small to attract customers, most of whom look for size as an indication of growth in later life, but this apparent deficiency of bulk is largely due to the compactness and evenness of form of the Berkshire pigling.

The standard of excellence issued by the British Berkshire Society is as follows:—

Colour: Black with white on face, feet and tip of tail.

Skin: Fine and free from wrinkles.

Hair: Long, fine and plentiful.

Head: Moderately short, face chisled, snout broad; and wide between the eyes and ears.

Ears: Fairly large, carried erect or slightly inclined forward and fringed with fine hair.

Neck: Medium length, evenly set on shoulders; jowl full and not heavy.

Shoulders: Fine and well sloped backwards; free from coarseness.

Back: Long and straight, ribs well sprung, sides deep.

Hams: Wide and deep to hocks.

Tail: Set high and fairly large.

Flank: Deep and well let down, and making straight under line.

Legs and feet: Short, straight and strong, set wide apart and hoofs nearly erect.

Imperfections: A perfectly black face, foot or tail. A white ear. A crooked jaw. White or sandy spots, or white skin on the body. A rose back. A very coarse mane and inbent knees.

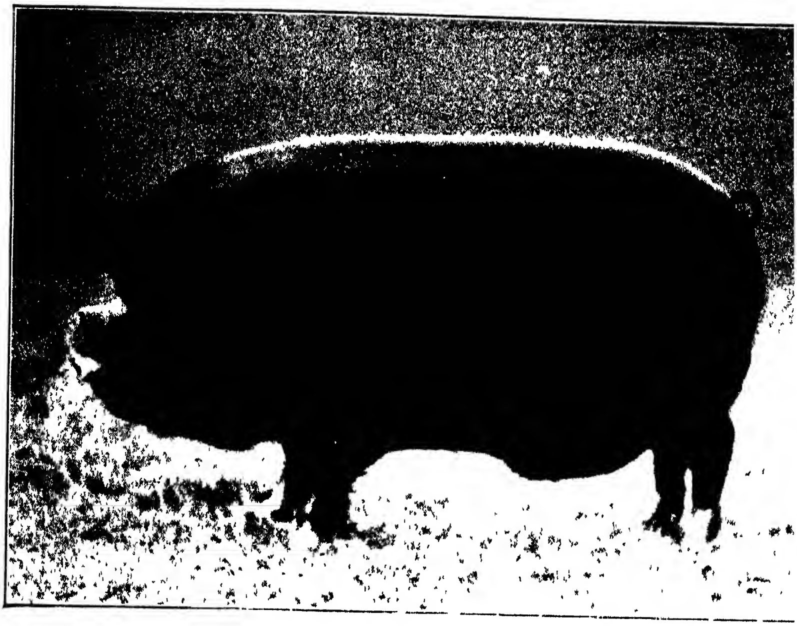

FIG. 1 Berkshire Boar A noted prize-winner.

FIG. 2. -Berkshire Sow: Also a well-known prize-winner.

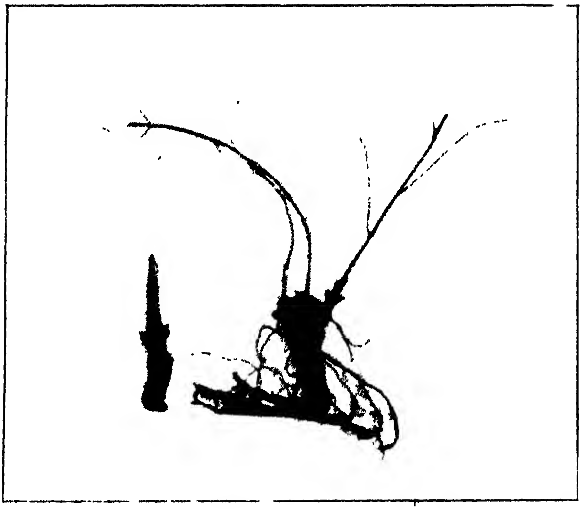

FIG. 1 A good Hop Set (right). Hop Cutting (left).
Note 3 Shoots and Fibrous Roots on the Set.

CULTIVATION OF THE HOP CROP.

I.

ARTHUR AMOS, M.A.,
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No British crop requires so much skill in cultivation nor so much technical and scientific knowledge on the part of the grower as the hop; each stage of the management will, therefore, repay the beginner who devotes to it endless observation and study.

Selection of Site.—The first problem is the selection of the site. Hop growing is carried out in well-defined areas, probably not so much by reason of the exacting nature of the hop plant for soil and meteorological conditions, important as these may be, as the fact that the hop requires very specialised skill and knowledge both on the part of the grower and also on the part of the labourers; beginners will therefore be well advised to start operations within or close to a hop district.

The site should possess a reasonably level surface, so that cultivations, and especially spraying, can be conveniently carried out. It should not be too exposed to the prevailing winds, or the crop may suffer great damage during growth and still more just before the picking of the hops; a well-sheltered situation is desirable or otherwise a situation that can be artificially well "lewed" by a poplar hedge or other device. A poplar hedge, properly cared for, grows very rapidly, but should nevertheless be planted two or three years before the hops so that it may begin to function as soon as the hops require protection.

The soil should be of considerable depth so that the deeply penetrating hop roots may get down several feet into the subsoil and thus be able to supply the growing plant with moisture during periods of drought. In some cases this depth of soil may be dispensed with if the rock below is weathered and of a brashy nature so that the hop roots can still penetrate deeply; with this exception shallow soils are not suitable for hops. The texture of the soil may vary considerably; the best soil is a calcareous loam, free-working and yet retentive of moisture, but in such districts as the Weald of Kent and parts of Herefordshire certain varieties of hops are grown on heavy clay soils with great success. Light sands and gravels, and sour or badly drained soils are not suitable for hops. For the successful growth of hops, the soil must be very rich both in plant food and in humus. It is preferable that

the original soil should be of this nature, and for this reason freshly-ploughed grass (provided wireworms are controlled) may provide a suitable situation for hops. In other circumstances the fertility may be artificially supplied by the use of dung, dung-substitutes and other artificial manures.

Another essential condition is adequate drainage; in the case of hops the water table should not be closer to the surface than 30 in. This means that if artificial drainage is necessary the drain pipes should be laid 3 ft. below the general level of the surface. In any case if artificial drainage is required, it should be carried out before the hops are planted so that the subsoil may be brought into proper shape before the roots of the hops begin to grow.

Consideration should also be given to the situation of the field in respect of access for carting water for washing or spraying, travelling of pickers, carting hops to the oast, etc.

Preparation of the Site.—Before any other steps are taken the field should be mapped and a careful plan made, upon which should be recorded not only the sequence of varieties it is proposed to plant but also details relating to the type and construction of the wirework contemplated (see Methods of Training Hops*), width and position of roadways, gangways, width of alleys and spacing between plants; this may need revision as new factors arise, but the existence of such a record in advance helps to prevent foolish omissions when actual planting occurs—omissions which can only be rectified at considerable expense.

Mention has already been made of the importance of drainage well in advance of planting; in close association with this careful attention should be given to the texture of the soil. In preparation for the preceding crops, ploughing should be increased in depth so as to provide a deeper root range for hops when planted; once also during this preliminary period it will be well to subsoil-plough the field, or alternatively use the steam cultivator to its fullest depth, care being taken that such deep cultivation is undertaken only when the subsoil is sufficiently dry to benefit by it. This deep cultivation, followed by the deep root-growth of the crops, will leave the soil in better condition for the growth of the hop roots and will render the drainage much more efficient.

During this period also the fertility of the field should be increased by the application of dung and other organic manures

* Mr. Amos will contribute an article on this subject in a later issue of the *Journal*.

as well by addition of such mineral manures as the soil may require.

Propagation and Planting.—Propagation of commercial hops is always " vegetative " by means of cuttings. Cuttings may be of two kinds—either the " straps " from aerial shoots of the previous season, or from underground stems or runners. The " straps " consist of the lowest 6 or 8 in. of the stem attached to the root stock, which have been earthed up in summer and swollen by the downward passage and accumulation of plant-food in late summer. In England these " straps " form the cuttings, runners rarely being used. On the Pacific Coast of America the cuttings are exclusively taken from the runners, because these are already supplied with rootlets and " strike " more easily, while they are less likely to dry out and die. More attention might be given to the use of runners for propagating " sets."

In England the general plan is to grow the cuttings one year in the open field to form " sets," and to plant them out into the hop garden at one year old; if, however, " sets " are unobtainable or are very costly, cuttings may be used for this purpose.

In selecting " sets " for planting it should be taken as an axiom that " the best are the cheapest "; each " set " should be well-grown with abundance of fibrous roots attached and with two or three good shoots. The " set " should not have withered leaves attached to the stems, since these indicate that they have been dug too soon in the autumn and will probably not grow; neither must they be " stags," *i.e.*, " sets " which have grown two years in the ground and have developed coarse as distinct from fibrous roots. (*See* illustration facing p. 891.)

Planting out.—The season for planting extends from November to the end of March, and on most soils early planting is preferable to late because of the danger of the plants drying out; probably a dry spell in February offers the best chance of success.

Before planting is begun the land should be cleaned, if necessary, then deeply ploughed, after which the exact position of each hop-hill should be measured out and marked by a stick or poplar cutting.

If " sets " are planted, one good " set " only should be put to each " hill," to avoid competition between plants, but if cuttings are used then two or three should be put to each. The " sets " are prepared by trimming the roots close back to the root-stock, and great care must be taken that they do

not dry out before planting. The best method of planting consists in dibbing a hole, putting the trimmed " set " in the hole so that the top is just above or level with the surface of the ground and pressing the soil tightly against the " set " by levering the dibber against it. If the weather is dry it is advantageous to scratch a little loose soil over the " set." When planting is finished the peg which marks the position of the " hill," should be replaced, so that the " set " can be seen and not be disturbed in subsequent cultivation.

It is of great importance that every " hill " should make a good start the first season, otherwise a very patchy crop will be produced the second season when, if the season is favourable, three-quarters of a full crop should be secured. It is, therefore, a wise policy to set aside up to 5 per cent. of the purchased " sets," trim them and plant them out in flower pots, so that, if upon examination in April it is found that some of the " sets " have died, the gaps may be replanted with potted " sets " and so produce a uniform plant.

If wireworms are present they are certain to attack the young hops and destroy the new shoots. To some extent this damage may be avoided by planting the " sets " not too deeply; further protection should be given by placing a piece of cut mangold about the size of a tennis ball by the side of each plant in March; the wireworms are attracted to the mangold and feed upon this instead of the hop-plant. The cut mangold can be examined once a fortnight with the object of collecting the wireworms and destroying them by scalding.

The young plants make much better growth and the resultant crop in the second season is benefited if short stakes or poles are provided upon which the shoots may grow during the first season.

The ground around the " hills " should be frequently cultivated, but care must be taken not to disturb the " sets " before they have taken root, or they are likely to dry out. The hops cannot take proper advantage of all the ground during the first year and a crop such as beans or potatoes, which are planted in wide rows, may conveniently be taken as an inter-crop; in this way the tillage of the inter-crop will at the same time benefit the hops, but such inter-crops must not be planted too close to the young hops lest they compete with them for plant food and water. On no account should sheep be allowed to eat the leaves of the young plants as when folding a crop of roots as an inter-crop, nor should the young " hills " be earthed up in their first year, or the result will be storage of plant food in the base of the

stems instead of in the root-stock; in the root-stock it provides a reserve of food for next season's growth, whereas the " straps " are cut off and so this reserve is wasted.

Cutting.—This operation is carried out for the purpose of keeping the hills in their place and preventing them from straggling all over the alley. It is desirable to keep the crown of the hill just level with the general surface of the ground. Two parts have to be cut off: the " straps " and the runners; on the Pacific Coast of America, where the hills are not earthed in summer, the operation is done with a sharp-edged spade; this is operated mainly for the purpose of cutting the runners, the spade being used to cut obliquely downwards and away from the hill. Under English conditions the hill is first cleaned from soil which has been put upon it during summer and then the " straps " and runners are cut off one by one with a sharp knife. The best time of year for this operation is during favourable weather in February or March, but may be carried out in autumn or as late as mid April.

Workmen often do much damage in cutting hops, being too severe on weak hills and too merciful to strong ones. The hops should be cut so that the crown is left just above the surface of the ground, in which position the young shoots are less liable to be attacked by wireworms. It is a frequent practice to scratch a little loose earth over each hill after cutting with the idea of protecting it; this idea is fallacious, for the stems arising from " hills " unprotected in this way are generally more firmly attached to the parent plant and less easily attacked by wireworms.

At the time of cutting attention should also be given to replanting any dead hills.

Cultivation.—The standard winter cultivation consists of two ploughings. *The first ploughing* is so managed as to turn the furrows towards the hills and so leave an open furrow down the centre of the alley. In the case of clay soils this first ploughing should be carried out very early in autumn so that the work may be done before the land gets wet and the open furrow may serve to keep the hop-plants drained through the winter. In the case of the more friable soils, where catch crops of rape and mustard are commonly sown before picking, the ploughing is delayed till the crop has been folded.

The second ploughing is carried out in spring as soon as the land is sufficiently dry for the purpose; this ploughing " gathers " the furrows to the centre of the alleys and levels

the land. Care must be taken that the last furrows next to the hills are not too deep, or too many hop roots would be cut.

The next operation consists in digging the " slips " between the hills where the plough has been unable to go, and at the same time the " hills " are opened for cutting.

Thorough spring cultivation should be given during March, April and May, whilst the soil is dry enough for tillage. This both kills weeds and aerates the soil. Spring cultivation should be above all things deep. Once in three or four years it is a good plan to use a steam cultivator at a depth of 12 to 15 in.; this not only provides for deep aeration but also facilitates drainage in the following winters and enables the soil to store up a greater quantity of water for the needs of the plant during summer. Another point to emphasize about spring cultivation is the fact that at this season it is not desirable to make the surface soil too fine; weeds can be more easily killed in a coarse-textured soil and, in the event of heavy rain, this sinks into the soil instead of being retained on the surface, making it sticky.

As summer proceeds the depth of tillage should be gradually lessened and automatically the texture will get finer; this is now desirable, since the fine soil at this season will form a mulch for the retention of water within the soil. Frequent cultivations are necessary as the surface gets beaten down by rain or trodden with other operations, for the purpose of aeration as well as to keep down weeds, but it is preferable to omit the cultivations rather than damage the texture of the soil by cultivating when too wet.

It is a moot point how long cultivation should be continued and probably the time should be varied according to the season, soil and quantity of manuring, etc., but in theory at any rate cultivation should be continued so that aeration may facilitate the production of plant food in the soil until the time when the hops are full grown. From this time onwards the supply of plant food should cease, because ripening and especially colouring of the hops is facilitated by withholding moisture and nitrogenous plant food from the roots. Late cultivation, by increasing the supply of plant food in the soil, tends to encourage the growth of new " bine " and " burr " so that the hops ripen in two crops. It also tends to delay the ripening of the plant generally. In practice it is difficult to decide at what stage to stop cultivation, and an interesting piece of investigation might be carried out upon this point.

(To be continued.)

INTERNATIONAL LABOUR CONFERENCE.

THE International Labour Conference recently held at Geneva devoted much attention to the conditions of agricultural labour, and although its conclusions on this subject do no more than affirm in many respects what is the common practice in this country, they constitute an interesting attempt to secure or ensure to agricultural workers throughout the world similar rights and privileges to those enjoyed by workers in other industries.

The first question that was put down for discussion was the regulation of the hours of work in agriculture on the analogy of the 8-hour day or 48-hour week which was the subject of a Convention at the first International Labour Conference held in 1919 at Washington. The French Government, however, lodged a formal protest against the inclusion on the Agenda not only of this question of the regulation of hours in agriculture, but also of other agricultural questions on the ground that it was not within the competence of the Conference as defined by the Peace Treaty to deal with agriculture, and, secondly, that even if agricultural questions could properly be regarded as coming within the scope of the Conference, the circumstances of the present time made it inopportune to discuss them.

A prolonged debate took place on these points but very little support was obtained for the suggestion that agriculture could be regarded as outside the scope of the International Labour Organisation. It was pointed out for example that although in the Peace Treaty the words "industry or industrial" constantly occurred, these words should be construed in the widest sense as including all forms of labour and that this meaning had already been given to them by the decision to deal with labour engaged in maritime shipping and in fishing. The "competence" of the Conference to deal with the question of agriculture was affirmed by 74 votes to 20.

Provision is, however, made in article 402 of the Peace Treaty to meet the contingency of a Government objecting to the discussion of any item on the Agenda, and in such a case it is laid down that a majority of two-thirds must be obtained to retain on the Agenda the item to which objection is taken. As the French Government had made a formal protest against the retention on the Agenda of the three items comprising the

agricultural questions, it was decided to take a vote on each item separately.

The subject on which feeling was most pronounced was the proposal for the regulation of the hours of work in agriculture. In the form in which this proposal was put to the Conference it amounted to no more than a recommendation that the regulation of hours of work should be voluntarily determined by agreement between organisations representative of employers and employed.

The question before the Conference at this stage was not, however, the merits of the proposal but merely the question whether this subject should be admitted for discussion. After considerable debate the matter was put to the vote and failed by five votes to obtain the necessary two-thirds majority, the figures being 63 to 39.

At a subsequent stage of the proceedings a Resolution was passed recommending that the question should be included in the Agenda of a future Conference.

This subject having been disposed of, there was little opposition to the remaining items relating to agriculture being considered and the necessary majorities were obtained without difficulty.

These agricultural questions were then divided into three groups and referred to separate Committees for consideration. The Committees reported, and after discussion certain Conventions or Recommendations were accepted and passed by the full Conference.

Prevention of Unemployment.—The Recommendation adopted on this subject dealt with the prevention of unemployment in agriculture from the point of view not only of directly taking measures to diminish unemployment but rather more generally to try to create a condition of greater stability and of increased employment of agricultural workers. In effect it merely suggests certain methods and invites the Governments to study those methods and to apply them as far as they can be made applicable in the particular conditions of each country, and to report how they work with a view to building up a body of information and experience amongst various countries.

The Recommendation is as follows:—

"Considering that the Convention and Recommendations concerning unemployment adopted at Washington are in principle applicable to agricultural workers and recognising the special character of unemployment in agriculture, the International Labour Conference recommends that each Member of the International Labour Organisation should

consider measures for the prevention of or providing against unemployment amongst agricultual workers suitable to the economic and agricultural conditions of its country, and that it should examine particularly from this point of view the advisability :—

(1) of adopting modern technical methods to bring into cultivation land which is at present not worked or only partially developed, but which could by such means be made to yield an adequate return ;

(2) of encouraging the adoption of improved systems of cultivation and the more intensive use of the land ;

(3) of providing facilities for settlement on the land ;

(4) of taking steps rendering work of a temporary nature accessible to unemployed agricultural workers by means of the provision of transport facilities ;

(5) of developing industries and supplementary forms of employment which would provide occupation for agricultural workers who suffer from seasonal unemployment provided steps be taken to ensure that such work is carried on under equitable conditions ;

(6) of taking steps to encourage the creation of agricultural workers' co-operative societies for the working and purchase or renting of land ; and of taking steps to this end to increase agricultural credit especially in favour of co-operative agricultural associations of land workers established for the purpose of agricultural production.

The International Labour Conference recommends that each Member of the International Labour Organisation furnish the International Labour Office with a periodical report dealing with the steps taken to give effect to the above Recommendation."

Compensation for Accidents.—In the case of this subject, there was general agreement that in those countries where forms of insurance against accidents were in operation, it was only reasonable that agricultural workers should enjoy the same privileges as other workers, and the Conference therefore adopted the following Convention :—

"Each Member of the International Labour Organisation which ratifies this Convention undertakes to extend to all agricultural wage-earners its laws and regulations which provide for the compensation of workers for personal injury by accident arising out of or in the course of their employment."

Rights of Association.—Similar considerations influenced the proposal to give to agricultural workers the same rights as industrial workers in regard to liberty of combination and association.

"Each Member of the International Labour Organisation which ratifies this Convention undertakes to secure to all those engaged in agriculture the same rights of association and combination as to industrial workers and to repeal any statutory or other provision restricting such rights in the case of those engaged in agriculture."

Insurance against Sickness, Old Age, etc.—Here again similar arguments applied, the intention being merely to afford the agricultural worker similar privileges to industrial workers. In this case, however, the Conference adopted the form of a Recommendation rather than a Convention as giving greater elasticity in view of the fact that social insurance might be adopted under special terms and conditions for certain groups of workers which could not be made applicable either generally or to agricultural workers as a group.

"That each Member of the International Labour Organisation extend its laws and regulations establishing systems of insurance against sickness, invalidity, old age and other similar social risks to agricultural wage-earners on conditions equivalent to those prevailing in the case of workers in industrial and commercial occupations."

Technical Agricultural Education.—In regard to the desirability of encouraging the development of vocational agricultural education there was practical unanimity and the following Recommendation was adopted:—

"That each Member of the International Labour Organisation endeavours to develop vocational agricultural education and in particular to make such education available to agricultural wage-earners on the same conditions as to other persons engaged in agriculture."

Women Workers in Agriculture.—Two Recommendations were adopted as regards women workers in agriculture, one relating to the protection of women before and after childbirth and the second relating to the employment of women at night. As regards the first, it may be observed that although this country has not accepted in its entirety the Maternity Convention of Washington, women workers have in practice in the National Health Insurance Acts similar privileges of a more extensive nature to those contemplated by the Convention.

In regard to the employment of women at night, this is, of course, very rare in Great Britain, and would only occur when the term night includes the early morning.

The Recommendation relating to maternity was as follows:—

"That each Member of the International Labour Organisation take measures to ensure to women wage-earners employed in agricultural undertakings, protection before and after childbirth similar to that provided by the Draft Convention adopted by the International Labour Conference at Washington for women employed in industry and commerce, and that such measures should include the right to a period of absence from work before and after childbirth and to a grant of benefit during the said period provided either out of public funds or by means of system of insurance."

The Recommendation concerning night work of women in agriculture was as follows:—

> "That each Member of the International Labour Organisation take steps to regulate the employment of women wage-earners in agricultural undertakings during the night in such a way as to ensure to them a period of rest compatible with their physical necessities and consisting of not less than 9 hours, which shall, when possible, be consecutive."

Children and Young Persons.—A very similar Recommendation was made in regard to the employment of children and young persons during the night. It will be observed that in both these Recommendations the period covered by the term "night" is not defined, the only requirement being that both in the case of women and children a definite period of rest shall be ensured.

The Recommendation concerning night work of children and young persons is as follows:—

> (1) "That the Members of the International Labour Organisation take steps to regulate the employment of children under the age of 14 years in agricultural undertakings during the night in such a way as to ensure to them a period of rest compatible with their physical necessities and consisting of not less than 10 consecutive hours."

> (2) "That the Members of the International Labour Organisation take steps to regulate the employment of young persons between the ages of 14 and 18 years in agricultural undertakings during the night in such a way as to ensure to them a period of rest compatible with their physical necessities and consisting of not less than 9 hours, which shall be consecutive."

A Convention was also agreed upon that had for its object the prohibition of the employment of children under the age of 14 in agriculture during the hours of school attendance. In the case of this country the Education Act of 1918 provides for the compulsory attendance of children up to the age of 14, and the provisions of this Convention are in accordance with existing practice so far as Great Britain is concerned.

The Convention concerning admission of children to employment in agriculture was to the following effect:—

> (1) "Children under the age of fourteen years may not be employed or work in any public or private agricultural undertaking, or in any branch thereof, save outside the hours of school attendance. If they are employed outside the hours of school attendance, the employment shall not be such as to prejudice their attendance at school.

> (2) "For the purpose of practical vocational instruction the periods and the hours of school attendance may be so arranged as to permit the employment of children on light agricultural work, and in particular on

light work connected with the harvest, provided that such employment shall not reduce the total annual period of school attendance to less than eight months."

(3) "The provision of Article 1 shall not apply to work done by children in technical schools, provided that such work is approved and supervised by public authority."

Living-in Conditions of Agricultural Workers.—In many countries this question is one of considerable importance, and the Recommendation adopted is intended to secure improved conditions in those cases where housing accommodation is provided by employers. It runs as follows:—

"That each Member of the International Labour Organisation which has not already done so take statutory or other measures to regulate the living-in conditions affecting agricultural work in its country and after consultation with the employers' and workers' organisations concerned if such organisations exist.

"That such measures shall apply to all accommodation provided by employers for housing their workers either individually or in groups or with their families whether the accommodation is provided in the houses of such employers or in buildings placed by them at the workers' disposal.

"That such measures shall contain the following provisions:

(*a*) "Unless climatic conditions render heating superfluous, the accommodation intended for workers' families, groups of workers or individual workers, should contain rooms which can be heated.

(*b*) "Accommodation intended for groups of workers shall provide a separate bed for each worker, shall afford facilities for ensuring personal cleanliness, and shall provide for the separation of the sexes. In the case of families, adequate provision shall be made for the children.

(*c*) "Stables, cowhouses and open sheds should not be used for sleeping quarters.

"That each Member of the International Labour Organisation take steps to ensure the observance of such measures."

It may be thought that comparatively little has been effected by the considerable machinery that is brought into play at an International Conference. Probably agriculture is of all industries least susceptible to international regulation, but something is accomplished if this fact comes to be realised after full discussion between the parties concerned—the employers, the workers, and the Governments. From the purely national point of view, again, British agriculture stands to gain if the restrictions on the unlimited use of labour which are dictated by humanity, and have become customary under our social conditions, can be thus incorporated in the practice of other competing countries.

THE PRODUCTION OF SEED POTATOES IN CUMBERLAND AND WESTMORLAND.

MAJOR OSWALD RILEY,
Ministry of Agriculture.

IT has long been recognised that the counties of Cumberland and Westmorland, owing to essential climatic conditions, are capable of producing seed potatoes of high quality suitable for planting in the midland and southern counties. It is evident that those growers who, foreseeing the inevitable spread of Wart Disease throughout the country, are specialising in the production of seed of immune varieties, are becoming alive to this fact. A large number of growers in Cumberland received the Ministry's certificate of purity for immune varieties in 1920; in fact, in cases of the more popular varieties 30 per cent. of the total number of growers of immune varieties in England and Wales were Cumberland farmers. In the near future there is certain to be an ever-increasing demand for " seed " of these varieties, and Cumberland growers would be well advised to organise this industry at once and place it on a sound basis.

An association of growers who could supply seed potatoes of the best quality, guaranteed to be grown in the best districts in Cumberland, would create a regular demand for their produce in the south, and the southern grower would be able to obtain first-class " seed " at a moderate price. From the point of view of the national food supply and the productiveness of the land, such a scheme might have a far-reaching effect, as without doubt the present low tonnage grown per acre, especially in the southern counties, is largely due to the use of poor " seed " or " seed " grown under unsuitable conditions.

The horticultural inspectors of the Ministry, in carrying out the work of crop inspection, have been able to collect valuable information as to the most favourable districts for raising seed potatoes in Cumberland and Westmorland, but while it is possible by means of personal inspection and observation to form an opinion as to suitability or otherwise of any particular district for this purpose, it is more satisfactory and convincing to prove this by means of statistics of climatic conditions, compiled during a long period of years, and at the same time to compare them with similar records taken in other potato growing districts which have already established a reputation for the production of seed potatoes.

Particulars of Districts.—For convenience, Cumberland may be divided into four districts, "A," "B," "C" and "D." There is only a small area in Westmorland suitable for potato growing, and that is included in District A. The observation stations from which the meteorological records have been taken are as follows:—

District "A" Newton Rigg, 559 ft. above sea level.
„ "B" Scaleby (east), 111 ft. „ „
„ "C" Aspatria (west), 487 ft. „ „
„ "D" Braystones (for rainfall only), 50 ft. above sea level.

District "A" is bounded on the north by the Carlisle-Newcastle railway, on the south by the Clifton-Appleby-Kirkby Stephen railway, on the east by the Pennine Range and on the west by the Carlisle-Penrith-Clifton railway. The soil is a loam to light loam. The formation in the east is Kirklinton and St. Bees sandstone and in the west sandstone and breccia.

The highest altitude at which potatoes are grown is 950 ft. and the lowest 300 ft. above sea level, the average being 450 ft. This is probably the best district in England for growing seed potatoes, as the soil and climatic conditions are uniform throughout. The conditions at Newton Rigg, the observation station, though just outside the boundary, are typical of the district.

District "B" is bounded on the north by the Scottish border; on the south by the Maryport-Carlisle-Newcastle railway; on the east by the Northumberland border and on the west by the Solway Firth.

The soil varies from light loam on the sandstone, alluvial on the alluvium, to heavy loam on the Keuper Marl and lower lias. The formation in the east is Kirklinton and St. Bees sandstone, in the west Keuper Marl, and on the coast alluvium.

The highest altitude at which potatoes are grown is 750 ft. above, and the lowest at sea level, the average being 200 ft. This district is nearly as suitable for potato growing as district "A," but there is a greater variety of soil and the climatic conditions are not so uniform.

District "C" is bounded on the north by the Maryport-Carlisle-Newcastle railway; on the south by the Penrith-Penruddock railway; on the east by the Carlisle-Penrith-Clifton railway and on the west by the Fell country.

The soil is a heavy loam, and the formation is of a limestone series. The highest altitude at which potatoes are grown is 800 ft., and the lowest 350 ft. above sea level, and the average 400 ft. This district is mostly laid down to grass, and therefore only small crops of potatoes are grown.

District "D" is bounded on the north by the Whitehaven-Cleator Moor road, by the Duddon Sands on the south, the Fell country on the east and by the sea on the west.

The soil is light loam running to sand on the coast line. The formation is Kirklinton and St. Bees sandstone. The highest altitude at which potatoes are grown is 400 ft., and the lowest at sea level, the average being 50 ft. This district is on the Cumberland coast and is suitable for the cultivation of early varieties of potatoes.

* The altitudes and soil formations are taken from the Ordnance Survey.

Factors Influencing Seed Production.—In determining the most suitable county or district for the production of seed potatoes for planting in more southern and warmer counties, the factors outlined below should be taken into consideration, and while in some districts certain suitable factors may be present to an exceptional degree, yet those districts could not be considered suitable for producing seed potatoes unless *all* the essential conditions were present.

(1) *Soil.*—The best soil is a loam or light loam, and for the latter a fairly heavy and regular rainfall is necessary in order that the seed may not become over-ripened. These conditions are found in districts " A," " B " and " D." The lightest land is usually found near the coast. In District " B " there is a certain amount of heavy loam running out to loam nearer the coast, and most of the potatoes in this district are grown on the loam.

(2) *Temperature.*—The mean temperature should be a low one and below that of the county to which the seed* is to be supplied. The temperature during the growing months, *i.e.*, April, May, June, July and August, should be sufficient to encourage luxuriant and healthy growth, and should be regular without being extreme. The temperature during the ripening months, *i.e.*, September and October, should be moderate in order that premature ripening may not take place. There is only a slight difference in temperature between the three Cumberland stations previously mentioned and the five Scottish stations situated at Dundee, Perth, Leith, Kilmarnock and Dumfries, Newton Rigg with 46.4° F. being the lowest, and Leith with 47.9° F. the highest. Taking the mean temperature for the growing months there is little to choose between the three Cumberland and the five Scottish stations. For May the Cumberland and Scottish stations average the same, viz., 50° F., and Newton Rigg 49.6° F. For June the Scottish stations show 55.7° F., and Newton Rigg 55.7° F. For July Scottish stations show 58.3° F., and Newton Rigg 58.4° F. and for August Scottish stations show 57.4° F., and Newton Rigg 57° F. In most months Aspatria and Scaleby show a temperature slightly higher than Newton Rigg. Other potato growing counties of England have a much higher temperature, *e.g.*, Lancashire 59.5° F. in August and Lincolnshire 61.3° F. in July; this is accompanied by a much lower rainfall.

For the ripening months there is little difference between the Cumberland and Scottish stations, the average for each being

* Late or main crop varieties are referred to.

practically the same, viz., in September, Cumberland 58.9° F. and Scottish 58.7° F.; in October, Cumberland 47.8° F., and Scottish 47.2° F. Newton Rigg shows the lowest temperature of all the stations for these two months, viz., 58.2° F. and 46.7° F. Lancashire and Lincolnshire are again several degrees higher.

(3) *Hours of Sunshine.*—Long hours of sunshine are very important during the months of growth, both for the formation of starch and the general health of the plant. Damp, sunless days favour the spread of blight and other fungus diseases. Too much sun at the end of the growing period and during the ripening period, if accompanied by a low rainfall, will produce over-ripened "seed." Scottish areas compare unfavourably with the Cumberland stations in hours of sunshine during May, June, July and September, but are nearly equal in August and October. Lancashire shows a distinct shortage of sun. Newton Rigg records more hours of sunshine in June than any other station, including Kew. This is the most important period for the formation of starch. The following is the average number of hours of bright sunshine each day for the two Cumberland and two Scottish stations

	May	*June*	*July*	*August*	*Sept.*	*Oct.*
Cumberland ...	6·18	6·60	5·82	4·98	4·50	3·01
Scotland ...	5·67	6·18	5·43	4·84	3·98	3·04

(4) *Rainfall.*—It may be generally stated that 35 in. to 40 in. per annum is an ideal rainfall for potato growing on loams and light loams. The rain which falls during the growing months should be sufficient to produce regular and vigorous growth and should be evenly distributed, without any periods of drought: the latter produces either premature ripening, or if followed by heavy rain, second growth. The driest period should be at the time of lifting. A sufficient rainfall is essential in April and May in order to start growth, and in June, July and August to stimulate it. A large number of rainy days indicates a constant and regular rainfall without periods of drought. In all these respects Cumberland compares very favourably with other potato growing districts, the rainfall being as high as in the chief potato growing districts of Scotland, while the number of rainy days is greater.

(5) *Altitude.*—Seed potatoes grown at high altitudes are less likely to become baked by the sun or to ripen prematurely. As a rule they are harvested later than in low-lying districts, when the sun has less strength, so that the final ripening is a gradual process and is not over-hastened by hot weather. There is also

the change, which is of value in planting on low ground, seed which has been grown at a much higher altitude, the difference in climate between the two altitudes being a strong factor.

(6) *Situation.*—Undulating land is more suitable for the production of seed potatoes for the following reasons:—

(*a*) Drainage is better (probably the land will be naturally drained), and so potato crops are less liable to disease, *e.g.*, Corky Scab, which thrives on undrained land.

(*b*) On undulating land potatoes are less liable to attacks of Blight which spreads rapidly on low-lying flat land. This is probably in a large measure due to the absence of air currents which are always present in undulating country.

(*c*) The sun, which is necessary for the formation of starch, has the greatest effect in this respect on land sloping to the south, and most arable farmers grow their potato crop on their best-situated fields. On such land the hottest rays of the sun (at noon) strike the ground obliquely, but later in the afternoon, when the rays are cooler, at more of a right angle, and so the heat of the sun throughout the day is moderated, and the greatest possible amount of starch is formed without fear of over-ripening. The reverse is the case on flat land, where the rays of the sun are not so moderated during the day but are more intense at noon and cooler in the evening. The whole of district "A" in Cumberland is undulating, and very few, if any, potatoes are grown on flat land. The same applies to districts "B" and "D" to a lesser degree.

(7) *Common Diseases.*—It may be safely stated that potatoes grown in Cumberland and Westmorland are, as a rule, remarkably healthy and free from disease. Though such diseases as Blight, Corky Scab, Black Leg, Mosaic, Leaf Curl, etc., are often present as in most potato growing districts, yet they are seldom severe enough to injure the crop to any considerable extent, and frequently little trace of these diseases can be found.

(8) *Capacity For Producing Heavy Crops.*—County trials have proved that with proper cultivation and manuring certain Cumberland soils can produce as heavy crops of most varieties of potatoes as are produced in other counties.

(9) *Accessibility of Markets.*—Owing to present high railway freights Cumberland growers have a good opportunity to build up a seed business by offering their potatoes at a moderate price to midland and southern growers who cannot afford to buy Scotch seed. Cumberland growers would thus greatly

benefit by securing a regular market and southern growers by an increase in crops. As county agricultural education progresses, growers in every county will become more alive to the necessity of obtaining suitable seed each year, without which the potato crop is always uncertain and frequently unremunerative.

INTERNATIONAL POTATO CONFERENCE.

THOUGH the potato has only been in cultivation in this country a little over 300 years it has long been a valuable article of food and now contributes a considerable amount to the national larder. It was estimated that between the years 1909 and 1913 the potato formed about one-fifth part by weight of the food eaten by the people of the United Kingdom; but until the period of food difficulties during the great War, the extent of our dependence upon the potato crop was realised by but a few. During this period strenuous efforts were successfully made by farmers, market gardeners, allotment holders, and private gardeners to raise such a quantity of potatoes as would provide a home-grown store of food in the event of imports of food supplies being very considerably reduced, or cut off completely.

The potato is not confined to the United Kingdom or to Europe, but is grown as a food crop, to a greater or smaller extent, in most places with a temperature varying between certain limits. Germany, with an area of over six million acres, grows more potatoes than any other country, France coming second with just over half that acreage, and the United Kingdom third with an area approximating to one and a quarter million acres; other countries grow smaller areas. It is estimated that the world's acreage devoted to this crop is about 33,000,000, with a total production of some 123,000,000 tons; the average yield, therefore, being about 3¾ tons per acre.

The yield is largely influenced by certain natural factors, such as soil, temperature and rainfall; as well as by methods of culture. It therefore varies widely in different countries, being highest in Belgium with 6.1 tons per acre. In the United Kingdom the yield is approximately 6 tons, Germany 5.9 tons, Denmark 5.7 tons, France 2.8 tons, and the United States

2.6 tons. The yields obtained in hot countries, like India, have not been ascertained, but they are understood to be small.

Those engaged in the potato growing industry in these countries are convinced that, under certain conditions, it is possible to lift crops of double and sometimes treble the weight of the average yield, and there is a great work to be done in every country in order to discover the factors limiting the size of the crops, and the means whereby these factors can be wholly or partially removed. In most instances it has been discovered that improved yields could be obtained by the use of improved strains of seed, and by the control of certain diseases to which the potato crop appears to be particularly susceptible.

Thus it was natural that the Delegates in Conference at the International Potato Conference held at the Royal Horticultural Society's Hall, Westminster from 16th-18th November, should more or less confine their discussions to these most important aspects of the matter. Mr. Wm. Stuart (U.S.A.), Mr. F. J. Chittenden (England), and Mr. Wm. Robb (Scotland), in their papers, showed that by selecting tubers from robust, vigorous plants it was possible to eliminate weak plants, and to build up strains superior to the unselected. There was agreement, however, that yield was not increased to the same extent as by using for seed tubers derived from crops grown in colder regions suitably supplied with a plentiful rainfall. The importance of this is now recognised generally, and just as England has chosen Scotland and northern Ireland as districts from which to obtain seed, so other countries are trying to discover suitable areas for producing their seed tubers. Thus, India obtains seed potatoes from Italy, Egypt from Spain, Bermuda from certain Canadian areas, and the growers in South America from selected fields in the north.

The home produced potato, therefore, does not appear to have retained its full powers of reproducing a crop, a discovery which had led to the popular belief that potatoes degenerate when continuously reproduced by asexual processes, *i.e.*, from tubers. Dr. Salaman (England) explained that this was not the true explanation, that continuous asexual reproduction had nothing to do with degeneration, and also that it was impossible to attribute the degeneration, if it existed, to general senile decay of the potato. He suggested that the loss of vigour was attributable to deterioration of the stock brought about by pathological diseases, and cited "Mosaic disease" as one of the causes.

Papers on Wart Disease read on the second day really focussed on the use of immune varieties for soils infected with the disease as the best solution of the problem for the present. Two readers expressed doubts as to the stability of the immune varieties, and Dr. Brierley in particular held to the possibility of immune varieties breaking down, and appealed for more research on the problem of soil sterilisation.

The delegates on the third day dealt with the "virus diseases" such as "Mosaic," "Leaf Curl" and "Crinkle," on which subjects Dr. Quanjer (Holland) gave a most interesting and instructive paper. Mr. Murphy (Ireland) gave, in a thoughtful address, an account of the work which he carried out on these diseases in Canada; whilst Mr. A. D. Cotton (England) reviewed the position in so far as Great Britain was concerned.

Judging from the papers there can be little doubt that the disease reduces the yield of the crop very materially, and that the productiveness of those varieties peculiarly susceptible to these diseases is impaired in a few years. It would also appear that improvements in the crops of most countries would be secured under some system by which tubers from healthy crops were only retained for planting.

Those interested in these matters should obtain a copy of the Report of the International Potato Conference which the Royal Horticultural Society has arranged to publish. All the papers read at the Conference, as well as the Presidential Address by Sir Daniel Hall who was unavoidably absent from England during the progress of the Conference, will be included in the report. Copies will be obtainable shortly from the Secretary, Royal Horticultural Society, Vincent Square, Westminster, London, S.W.1. Price 3s. 4d. post free.

STRAWBERRY GROWING IN THE CHEDDAR VALLEY OF SOMERSET.

A. D. R. WALBANK, N.D.A.
Ministry of Agriculture.

CHEDDAR VALLEY is situated about twenty miles south-west of Bristol and is completely protected from the north and partially from the east by the Mendip Hills. The Valley extends from the village of Cross to the county town of Wells, but only the area lying between Axbridge and Draycott is used for strawberry growing. A branch line of the Great Western Railway serves the Valley. The Mendip Hills rise fairly steeply out of the Valley, and it is chiefly in "pockets" on the slopes of these hills, and at their base, that market gardening is carried on. Although the geological formation is carboniferous limestone, at least three types of soil are met with—a brashy soil on the higher slopes; a light red marl; and a black soil, which does not appear to be entirely devoid of clay in the lower levels.

Growth of the Industry.—Market gardening has flourished in the district for many years, but the introduction of strawberry growing on a commercial basis dates back only some 35 years. It was first commenced at Axbridge. For several years market gardeners were suspicious of the financial returns to be derived from the new crop, but when the ordinary early vegetable crops of the district realised lower prices in Bristol market there was a rush to take up strawberry growing, which reached its maximum about fifteen years ago. It then suffered a gradual decline, which was accentuated by various disturbing conditions operating during the war-period. At the present time the area under market gardens is probably about 650 acres, of which some 300 acres are under strawberries. Other crops are early potatoes, peas, beans and turnips.

Strawberries are usually left down for three years and are cropped as one-year-old plants. The principal variety grown is Royal Sovereign, but a few Kentish Favourites, Laxtons and Nobles are to be found. When the three-year-old plants are removed, potatoes and other crops follow for two years to admit of thorough cleaning before planting strawberries again. During the past year it is estimated that 60-70 acres of market garden land has reverted to strawberries; a few new holdings are also being developed. Suitable land is still obtainable between Cheddar and Draycott, and there appears to be no reason why

the strawberry growing area should not be extended in the direction of Rodney Stoke and Lodge Hill. The chief feature of the district is its earliness.

Size of Holdings and Types of Growers.—The average size of the holdings is about two acres. Many growers hold considerably less, others more, but holders of ten acres are few and the writer knows of only one holding of 20 acres. The larger holdings are usually worked as joint family concerns. In one instance, three brothers who are considered prosperous men support themselves and their families on seven acres of market garden land, three acres of which are under strawberries. They have, in addition, five acres of grass for pasturage and hay for the horses. Strawberry growing necessitates very close application to work at certain seasons of the year, and it is considered locally that two acres (one of which is under strawberries) is enough for one man to look after, except in the picking season, when outside labour is employed. The majority of growers rent their holdings. Rents vary from £2 to £7 per acre, according to situation, and a fair average is £5. Rates are approximately £1 6s. per acre.

Rather less than one-half of the growers are entirely dependent on market gardening for a living. The majority combine other work with it: some are in business as tradesmen or small shopkeepers; others are farmers; the remainder obtain casual labour during the winter. Thus a type of worker is evolved who is only semi-dependent on his holding, who retains considerable independence, and who is better off financially than a labourer. The poverty line is seldom reached and the growers generally are a contented class.

System of Cultivation.—Strawberries usually follow early potatoes or peas, and it is the practice to take runners from one-year-old plants as soon as rooted. Growers endeavour to ensure that the runners are planted not later than the second week in August, as it is from the early runners that the earliest fruit is obtained. The usual distance between the rows is 2 ft. and the plants are about 9 in. apart. This allows of nearly 27,000 plants per acre. Wherever possible, growers prefer to use farmyard manure, but where this is unobtainable various artificial manures—generally bought as compound strawberry manures—are used. The young plants are heeled in practically on the top of the artificials. Some growers give a small dressing of sulphate of ammonia or superphosphate in the early spring. The estimate in the district for manure is £10 per acre.

Cultivation after planting is devoted entirely to keeping the land clean. About January the space between the rows is forked by hand. This is termed locally "spitting in" and one man will fork an acre in 12 days. During the spring the land is hoed as required, generally at least twice, and one man will hoe an acre in 6 days. Strawing down the plants is not usually practised, but a few growers use bracken for this purpose if no dung has been applied.

Growers' Organisation.—The Cheddar Valley Fruit Growers' Association was formed in 1912 and largely owes its inception to the Agricultural Organisation Society. It is affiliated to the National Federation of British Growers, and has a membership of about 160. The Association has a strong marketing committee, which meets nightly throughout the season and virtually decides the markets to which the following day's crop shall be consigned. It also gives valuable assistance to the Railway Company by indicating the probable number of railway vans required, and their destinations. The question of a guarantee of the weight of fruit in each chip (at present this is 4 lb. net) is being considered by the Association, which is also concerned with the difficulty of obtaining adequate supplies of manure. It arranges lectures for growers by the County Horticultural Superintendent in the winter months; and it is drawing up a scheme to establish, at its own expense, variety and manurial trials with strawberries, with a view to exploring the possibilities of further local development.

BEE-KEEPING IN NORFOLK.

H. GOUDE,
Horticulture Adviser to Norfolk County Council.

IN the initial stages of all industries, when they are struggling to gain recognition, there is a time when the application of advanced knowledge and wise legislative assistance will lead individual efforts to a collective and full realization of their aims. Bee-keeping goes back to the dim ages, but modern apiculture has developed improved methods and bees during the past few years, and is just emerging from the infant stage of a re-birth to take its place on the wide road of vigorous maturity with a modicum of paternal fostering.

The Norfolk Education Committees have encouraged bee-keeping for more than twenty years; they have proved that the craft will bear favourable comparison with any of the minor industries of the country-side, and that it is, in fact, a profitable adjunct to both agriculture and horticulture. The Norfolk villages of Feltwell and Methwold are mentioned in the Doomsday Book as being good districts for keeping bees, proving that our forebears did not neglect apiculture. With no substitutes for honey and wax, bee-keeping was for them a major occupation. The two villages mentioned are first-class positions for bee-keeping to-day.

Scheme of Instruction.—The general scheme of practical instruction provides for demonstrations at shows, and for lantern lectures during the winter evenings. These two items of work bring the expert in personal touch with bee-keepers and prospective beginners, and directly lead to visits to apiaries. Some of these apiaries are used as demonstration centres for the district: a demonstration is advertised and from twenty to forty people attend. The expert shows a seasonable operation and many of the audience—frequently the majority—perform the same work on different stocks of bees under his supervision. In this way, skill in manipulation is increased, and confidence in handling bees gained. A close touch is kept with these demonstration apiaries; monthly reminders are issued and further visits made at important periods in the season. At the end of the season an expenditure and receipt account is made out for each centre.

Norfolk Demonstration Apiaries.

Apiary No.	*Number of stocks.*	*Weight of surplus honey.*	*Season's expenditure.*			*Season's receipts.*			*Profit.*		
			£	s.	d.	£	s.	d.	£	s.	d.
1.	7	493 lb.	3	15	0	39	6	0	35	11	0
2.	13	1,000 „	22	10	0	108	0	0	85	0	0
3.	8	559 „	10	7	6	57	7	6	47	0	0
4.	8	196 „	5	7	0	12	5	0	6	18	0
5.	2	50 „		10	0	3	15	0	3	5	0
6.	17	1,121 „	19	0	0	93	0	0	74	0	0
7.	7	300 „	2	10	0	22	10	0	20	0	0
8.	14	998 „	15	0	0	74	17	0	59	17	0
9.	1	48 „		5	7	3	14	0	2	7	5
10.	2	123 „		17	6	9	4	0	8	16	6
11.	3	78 „		11	0	7	17	0	6	16	0

In these balance sheets ten per cent. is allowed *for depreciation* on the capital expenditure; this is found to be ample, as the equipment of an apiary is serviceable at the end of ten years, and even at the end of twenty years. The cost of wax foundation and frames should be reckoned as capital expenditure as they remain in the apiary five years, but the cost of these is charged as current expenditure. Everything that is bought for the production of honey, wax, bees and maintenance is included. Time is not charged for, owing to the difficulty in assessing it, and beginners usually waste time in unnecessary work. The balance sheets from the centres include the results from some of the most skilful bee-keepers who readily availed themselves of the instruction.

The county scheme also provides for grants to local societies for approved work; the teaching of bee-life and the making of bee hives in elementary schools; and the establishment of a county apiary. Several elementary schools have practical bee-keeping classes.

Acarine disease practically depleted the county of bees from 1910 to 1914, and bee-keeping was abandoned in places where it had flourished. This was a most disheartening period. The introduction of Italian queen bees, obtained chiefly through the Ministry of Agriculture's scheme, has had excellent results; the county has again many thriving apiaries and progress is still being made. Within a mile of East Dereham there are 100 stocks of bees built up since 1914. With actual results in view it is estimated that Norfolk is capable of producing an annual average output of 1,000 tons of honey. Bees are a potential source of food, as the nectar secreted by flowers is entirely lost if not gathered by them.

Fig. 1 shows one of the apiaries built up under the guidance of the county expert; each hive contains a thriving colony of bees, and the produce last season was half a ton of honey, a few pounds of wax and six stocks of bees.

Practical Work.—In the practical instruction the British Bee-keeper's Guide Book is used as the source of information, but we also read the bee literature published in America, in the Colonies and the home journals, "skimming the cream" of any new ideas and trying them out. Past experience makes us cautious in adopting new inventions until we have appraised their value. It is advisable to keep to the smallest number of simple appliances consistent with efficiency, and to become thoroughly skilful in their application rather than have a multi-

plicity of tools and methods. The W.B.C. type of hive is recommended; its possibilities of extension and contraction fulfil all practical demands. This hive is a perfect home for bees if kept painted so that it is watertight. In the same manner the British standard and shallow frames serve every practical purpose.

Italian bees are favoured owing to their docility and powers of working. They are less susceptible to brood diseases than other races. A few queens are imported each season and introduced to the stocks in each apiary. The best of these pure queens are kept for breeding in their second season; the resulting bees are vigorous and with few exceptions very easy to handle.

The position of the apiary should be sheltered from prevailing winds and in a dry position; for the latter reason a grass bottom is not desirable, but gravel, ashes or cultivated land are preferable. Bees thrive best in a dry, warm, light, airy and quiet position; shade from trees is a disadvantage. Full advantage can be taken of an open sunny position by painting the hives white. In the spring we stimulate the queens by uncapping stores and interchanging combs, but unless the weather is warm the brood nest is not split. Syrup feeding is started in April, if necessary. Towards the end of April the strongest stocks are doubled, and if the season is early all the stocks crowding the brood chambers are supered in May. The first super consists of shallow frames containing brood combs, narrow spaced, as an addition to the brood chamber. Queen excluders are then put on and further supers added when necessary. This system gives very few swarms. The bees begin work on the cherry, plum, apple and bush fruit blossoms. Raspberry honey is particularly good. The blossoming of these fruit trees is closely followed by bean, sainfoin and clover, and, later, by turnip, cole seed and buckwheat. The important point in summer management is to keep large colonies of bees, with ample room for storing, ready to take advantage of any nectar flow which the crops and weather produce.

Comb honey is taken from the hives as soon as it is sealed, once every nine days during the season. The sections are then cleaned, graded and packed away (Fig. 5). The extracted honey is taken when convenient, or left in the hives until August; but farmers usually prefer doing this work in July, before harvest commences. The hives are then put into trim for wintering and doubtful stocks re-queened.

FIG. 1. Apiary built up under expert supervision.

FIG. 2.—Uncapping shallow Combs for placing in the Extractor (on the right).

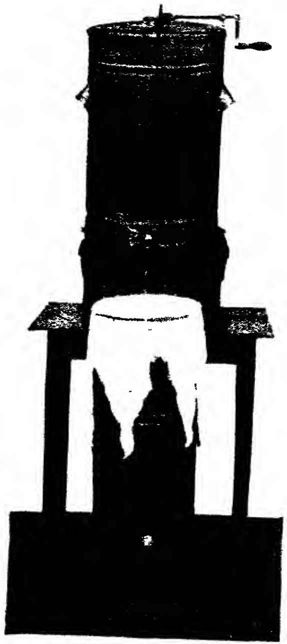

Fig. 3.—Running Honey from Extractor through muslin into Refiner.

Fig. 4.—Bottling Honey ready for sale

Fig. 5.—Cleaning Sections of Comb Honey.

The principal points to remember throughout the year are to have the best queens, strong stocks, ample stores, and weather-proof hives. The surplus honey combs are taken when all cells are sealed, the cappings are cut off and allowed to fall into the top of a ripener lined with butter muslin, and the honey is extracted (Fig. 2). When the honey in the extractor reaches to the spindle socket, the cappings in the top of the ripener are tied up, and the muslin bag thus made is hung over a basin to drain. A clean piece of muslin is now placed over the ripener and the honey in the extractor is strained as it is run into the ripener Fig. 3). The honey is now free from particles of wax and ready for putting into jars (Fig. 4). Plain glass jars are used, and every effort is made to make the jars of honey bright and neat. An attractive label is used and the honey readily sells.

The Committee has found that one year in ten produces an exceptionally good supply of honey; one year is very poor, and the remaining eight years vary from good to moderate. In 1911 the late Mr. Bunkle, of Brancaster, obtained two tons of honey from 21 stocks of bees, while the flow in the following year was very poor. In 1921 the supply proved exceptionally good.

The intensive and extensive development of apiculture is seriously menaced by casual keepers of bees. For instance, an old infected hive left in an out-of-the-way place in a garden is repeatedly tenanted by straying swarms. Disease sets in and the bees die. The stores are then robbed by bees from apiaries miles apart, setting up new centres of infection. In several instances the writer has traced the source of the ruin of hundreds of stocks of bees to this careless practice. At present there is no law to prevent the sale of old infected hives which spread ruin to apiaries over wide areas. This retards development; the experienced bee-keeper hesitates to put more "eggs" into his bee-keeping "basket."

The abstract value of apiculture to agriculture and horticulture is of considerable importance, and the annual loss of hundreds of tons of one of Nature's choicest foods should be rectified.

TESTING STATIONS FOR AGRICULTURAL MACHINERY.

AGRICULTURAL Machinery Testing Stations have been established in many continental countries:—France, Germany, Austria, Scandinavia, Holland and Belgium. Italy too is soon to have one. The object of such a station is to test, scientifically —which means also practically—such machinery as may be submitted to it, and to issue reports thereon, public or confidential as the case may require. To these functions it may add the collection—both in the course of actual trials as well as from other sources—of all data bearing on the subject of agricultural machinery; and investigations, both theoretical and practical, on such questions as may from time to time suggest themselves. The station may or may not add education to research.

To take a concrete instance. Sweden, with a population of about 6 million (or roughly 1/6th of that of England and Wales), has two testing stations—Ultuna and Alnarp. A Director of Testing is responsible for the work at both stations, each of which has a staff consisting of a professor, an assistant engineer, a farm manager and two mechanics. The number of machines tried in 1914 was 200; in 1916, 82 (Ultuna 46, Alnarp 36). It should be mentioned that Alnarp specialises in milking machinery. Both these institutions owe their existence to a gift in 1896 of some £5,000 from the Separator Company, a gift which at any rate so far as the Company is concerned, seems to have been particularly well placed, to judge from the reputation for dairy machinery which Sweden enjoys to-day. In addition to the two testing stations for agricultural machinery, there is in Stockholm a testing station for materials, which possesses what is considered the most modern laboratory equipment for the purpose in the world.

The programme of the two testing stations is simple. There are, on the invitation of the Testing Committee, public trials (known as trials in series) designed to test a number of implements having a similar purpose. Besides this any individual may for a fee, graduated according to its value, submit a machine for trial, or for expert opinion. Reports on the public trials are published. The publication of the report of an individual trial is, with certain restrictions, at the discretion

of the entrant. At any trial the manufacturer has the right to be represented.

The reports are comprehensive documents, which, to take as an instance an individual trial of a tractor and plough, may extend to some 40 octavo pages. In addition to more or less obvious heads of information, such as draw-bar pull, brake tests, adaptability of tractor for haulage and stationary work, the report includes details as to behaviour, especially in steering and turning, safety of the engine, number of interruptions with their duration and cause, ease with which parts can be replaced, and comparison, where possible, with a single furrow horse plough. The practical ploughing trial was carried on for 14 days. The result of the brake tests are given in a table accompanied by a graph showing consumption of fuel at the various developed h.p. A short conclusion, in simple terms, sums up the detailed report.

The reports of comparative trials or trials in series are also comprehensive and are the more illuminating in that each phase of the trials is represented in tabular form showing the performance of each implement.

Trials are not merely conducted in the field. Many details admit of, if they do not absolutely require, investigation in the laboratory. Nor are all trials concluded when the machine, whatever it is, has been returned to the owner. The value of many implements of cultivation cannot be thoroughly tested until the crops, sown on the ground which they have worked, have been harvested, and it is interesting to note in this connection a Swedish account of trials of subsoiling ploughs in which comparative yields of the first crop taken (wheat) are included in the final report. It can with justice be urged that one cereal crop is not very adequate evidence on so debatable a subject; an absolutely scientific test might be held to require no less than a whole rotation: but the immediate point to be noted is the principle which governs the inclusion of such data at all in the report.

Any one single testing station is not dependent solely on itself. One of its duties is, as already explained, the collation of data already obtained elsewhere and, as is shown later, there is among the European stations a considerable amount of agreement as to the lines on which such data should be recorded.

Thus the merits and shortcomings of previous machines of any given type can be fully ascertained, and accumulation of experience from the past may obviate the need for fresh

experimental work or may determine the direction which experimental work shall take.

Another direction in which this accumulated experience will be of service is in the preparation of reports of trials. So long as every machine is practically regarded, for the purposes of the trial, as a new machine and as such submitted to test, the working up of the mass of detail collected will involve much labour and tend to delay the publication of reports. Results already recorded both at home and, still more, abroad will serve as a standard of comparison; they will indicate the points to be stressed, and may even show where a new machine falls short of a predecessor; they may also enable the detail contained in current reports to be cut down to a minimum, although it may be questionable whether in the long run there is much to be gained in this way.

As regards the method of drawing up reports it may be noted that most of the Continental Stations are in accord with one another. The question of uniformity in this respect was raised at a conference of International Agricultural Engineers, the first of its kind, held at Liège in 1905. At the International Agricultural Congress (which included at the same time the Second International Conference of Agricultural Engineers), held at Vienna in 1907, Professor Josef Rezek, of that city, whose services in this direction can scarcely be too highly appreciated, brought before the agricultural machinery section a recommendation as to the general lines that should be universally adopted in drawing up reports on tests of agricultural machinery. This, with a few amendments, was agreed to, as were also a number of other similar recommendations dealing in detail with different types of machinery. These instructions, though leaving open to some extent the methods to be employed, lay down the lines on which scientific testing should proceed and thus tend to promote uniformity.

Every phase of applied science has its special problems, and the problems of agricultural engineering are perhaps more specially complicated than, and often very different from, those with which other branches have to contend :—

(1) The bulk of agricultural machinery must be capable of working efficiently under a wide variety of conditions both of soil and weather.

(2) The machine must be economical in use, and to meet this requirement must, broadly speaking, be produced in mass.

(3) There is no purely practical method of testing its efficiency that will not in general require at least one season. A plough, for instance, may do admirable work, when only the actual operation of ploughing is considered, but, as was pointed out by a witness examined by the Departmental Committee,* the resultant crop may not be commensurate with the apparent quality of the purely ploughing work accomplished. A rotary cultivator may produce, or appear to produce, an excellent tilth in one operation, but its work needs to be tested by the touchstone of economics—which is to-day a crystal of many facets. A drill may deposit seed and fertiliser ideally, but its true value cannot be appraised until it has been established how, among other things, the resulting crop has tillered.

The solution of the first of these three problems must be mainly sought on the lines of the closest co-operation between the mechanician and the soil physicist, to whom must be added the botanist and the plant pathologist.

The two other problems scarcely admit of independent solution; they are inextricably intertwined with one another. The task of producing in mass an implement that cannot, according to present method, be fully tested in less than a season is one that makes many demands upon the manufacturer. It is true, as has been indicated above, that he has the collected experience of centuries to help, nor is he without means, commensurate with the extent of his business, of testing any new design or proposed modification before it is placed on the market. Still there is the danger, greater of course in smaller establishments, lest either partiality to a design or inefficiency of test should result in leaving on his hands a serious quantity of unmarketable stock, or, worse still, of placing in the hands of the farmer a relatively inefficient tool.

From such a danger an impartial testing organisation, fully equipped with staff and material, would be a considerable safeguard. The fear lest the tendency of such a body would be to suppress individuality and circumscribe the scope of private enterprise is sufficiently dispelled by the whole history of such institutions abroad. For a manufacturer who looks beyond his own country for a market, the value of such an institute, ever collecting and collating information from every quarter of the globe, issuing a certificate which would be everywhere accepted without question, and offering, if desired, technical advice

* [Cmd. 506] 1920 p. 61.

based upon scientific methods and broad experience, would be incalculable.

Many of the countries that once imported freely have either been schooled by circumstances to provide for their own needs or have been reduced in purchasing power. They will buy nothing unless convinced that they are buying what is better and in the long run cheaper than what they can themselves produce. Failure of any implement placed on a foreign market will prejudice indefinitely not only the firm but the nation producing, and the less qualified the purchasers are to account for the failure, the deeper roots their prejudice will strike.

Agriculture was the first-born of human arts. It has changed, no doubt, since the period chosen as a settin, of the earliest and noblest of human stories, which saw in the first inhabitant of our world a gardener, and a keeper of sheep and a tiller of the earth in his sons. Our need of it, however, is not one whit the less. Never perhaps in the history of humanity has there been so real, so purposeful a resolve to beat swords into ploughshares. Never certainly in the history of humanity has there been so sore a need that the converted product should be economic and efficient.

LAND DRAINAGE AND UNEMPLOYMENT.

AT the beginning of November a substantial sum of money was placed at the disposal of the Ministry for carrying out drainage schemes with the primary object of relieving unemployment.* Out of this Fund, advances are made by the Ministry (*a*) to Drainage Authorities, and (*b*) to County Agricultural Committees, to defray the cost of drainage schemes submitted to and duly approved by the Ministry.

Drainage Authorities are required to repay to the Ministry 25 per cent. of the net cost of each scheme within six months of its completion.

Agricultural Committees, which can only carry out schemes on a purely voluntary basis, are required to secure from the affected landowners and occupiers undertakings to repay 33⅓ per cent. of the estimated cost of each scheme. This repayment may in suitable cases be spread over a period not exceeding two years, the deferred payments bearing interest at 5 per cent.

* See this *Journal*, December, 1921, p. 839.

The conditions upon which money is advanced by the Ministry under this scheme may be repeated here. They are as follows:—

(*a*) All work must be done as far as possible by hand labour;

(*b*) 75 per cent. of the labourers must be ex-service men, if available;

(*c*) Of the remaining 25 per cent., the majority must be married civilians, if available;

(*d*) Wages payable for ordinary labour will be the agricultural rates current in the district. The only men who may be paid in excess of the agricultural rates are gangers, foremen and skilled men such as carpenters and smiths;

(*e*) The works will be inspected by the Ministry from time to time and progress reports will be called for as and when required.

The main object to be achieved is to get unemployed rapidly on to suitable work, and every possible effort is being made to prevent any formalities standing in the way of work being started promptly.

The possibility of undertaking works of land drainage, or of reclamation, for the relief of unemployment, or of assisting such works financially, has been discussed for many months, and many prominent agriculturists and others have urged that such a policy should be adopted.

The suggestion that works of reclamation, particularly on the foreshore of the Wash, should be undertaken by Government has also been very freely advocated, and is undoubtedly attractive at first sight. There are, however, in the Ministry's opinion almost insuperable difficulties. Work of this kind would have to be carried out on remote and exposed parts of the coast and would involve housing accommodation for large numbers of men as well as provision for supplies, amusement and policing, in most cases at a considerable distance from rail-head. It will be readily understood that such necessities as these would add enormously to the cost of any work, and also that the first requirement for keeping down the cost would be the employment of the greatest possible number of men at a time on each work. It will also be evident that, owing to the situation of the works, the conditions during winter would be extremely unfavourable and calculated to lead to long periods of almost complete idleness.

In any case, the construction of embankments by hand labour is an extremely uneconomical method of reclaiming foreshore land at the present time. Experts have been considering the possibilities of using machinery of various kinds for such

construction, and other researches have led to the conclusion that in the near future, if not at the present time, embankments can be constructed by machinery at a very much lower cost than by hand labour. The adoption of such mechanical appliances would, to some extent, overcome the difficulties of housing and winter weather conditions, but would render the work comparatively useless as a means of relieving unemployment. It was mainly therefore on account of these difficulties that the Government decided that no works of foreshore reclamation should be undertaken with the funds now available.

Land drainage work, on the other hand, by which is meant, generally speaking, the improvement of water courses with a view to the diminution of the injurious flooding and water-logging of agricultural land, undoubtedly offers far greater opportunities for useful relief works. It is even capable of being carried out during the winter, and the difficulties involved are comparatively small. It was therefore decided that the fund at the disposal of the Ministry should be used only to assist works of land drainage.

The primary object of the Ministry is the relief of unemployment in rural areas. The unemployed workers in these areas are generally found in small groups over scattered districts, and it will be apparent, therefore, that more effective relief can be afforded by a large number of small schemes employing comparatively small numbers of men, than by a small number of large schemes in isolated areas. Moreover the larger the number of schemes the wider distributed becomes the benefit to agricultural land.

A further very substantial advantage of land drainage works as compared with works of reclamation is that the former, if interrupted by bad weather, can be resumed at any time where left off, without any substantial amount of the work having to be done over again; moreover, land drainage works are not necessarily confined to small schemes, and in suitable cases larger works can be undertaken within a short distance of urban areas which will relieve not only agricultural workers, but considerable numbers of unemployed men from the towns.

The offer of assistance which has been made by the Government has up to the present been taken up very satisfactorily. Up to the 17th December, 49 schemes submitted by Drainage Authorities and 18 schemes submitted by County Agricultural Committees had been approved.

The estimated number of men to be employed was 3,003, and the estimated number of man-weeks was 50,204. The estimated cost of the schemes was as follows:—

Wages	£105,639
Materials	8,772
Special staff and supervision	4,004
Total ...	£118,415

The comparatively few schemes which have actually been put in hand by County Agricultural Committees does not indicate any want of activity on the part of those bodies. On the contrary, in a large number of Counties, meetings of land-owners and occupiers have been held to consider numerous schemes, and agreements to repay to the Ministry the prescribed percentage of the cost of the schemes are being obtained. The difficulties, however, of organising voluntary schemes of this nature are obvious, and it is not to be expected that such schemes will be anything like so numerous or so large as the schemes submitted by Drainage Authorities.

In conclusion, two interesting points may be mentioned which have been prominent in the reports of the Ministry's Inspectors. The first is that there has been no difficulty in obtaining unemployed men of the class which it is particularly desired to relieve and that all available ex-service men have been employed in every case. The second point is that the men are taking readily to the work and are doing far better than was generally expected, although the work is not only trying but is entirely new to the majority of them.

THE BARN-OWL.

WALTER E. COLLINGE, D.Sc., F.L.S.
Keeper of the Yorkshire Museum, York.

FOR ages past the commoner species of owls have been regarded by farmers and landowners as most beneficial birds, but during the past few years, when the character of many wild birds has been called into question, that of the Barn-Owl (*Strix flammea*, Linn.) has been greatly maligned. Stories which have been told of its depredations on young game birds and rabbits, even in broad daylight, have been too quickly believed and passed on.

In 1919 the writer prepared a note* giving a volumetric analysis obtained from an examination of twelve stomachs secured between March and October. Since that date he has had the opportunity of examining further specimens, and the figures

* *Journ. W.B.I. Soc*, 1921, Vol. i, p. 9.

remain practically the same. Moreover, from the Eastern and Midland counties of England a large series of pellets has been received and examined, and in view of the results obtained, it seems very desirable to re-state the case for this useful and interesting species, particularly at a time when farm vermin has

FIG. 1.—The Barn Owl (*Strix flammea*).

greatly increased and is imposing a severe tax upon the agriculturist. Too often the farmer and landowner do not bear in mind the enormous number of rats, mice and voles that are destroyed by this and other species of wild birds. If any professional rat-catcher were to guarantee the destruction of a tithe of these, he would be welcome to take payment in a brace or two of game birds.

The Barn-Owl is common and resident throughout Great Britain and Ireland, though it is less numerous in the north of Scotland. It is strictly nocturnal, remaining asleep during the daytime in old ruins, barns, church towers and other buildings, and occasionally in the hollows of trees. At dusk it flies abroad, seeking its sheltered retreat as day breaks. If unmolested it frequents inhabited places, indeed seems to prefer the vicinity of houses, etc., to the open country.

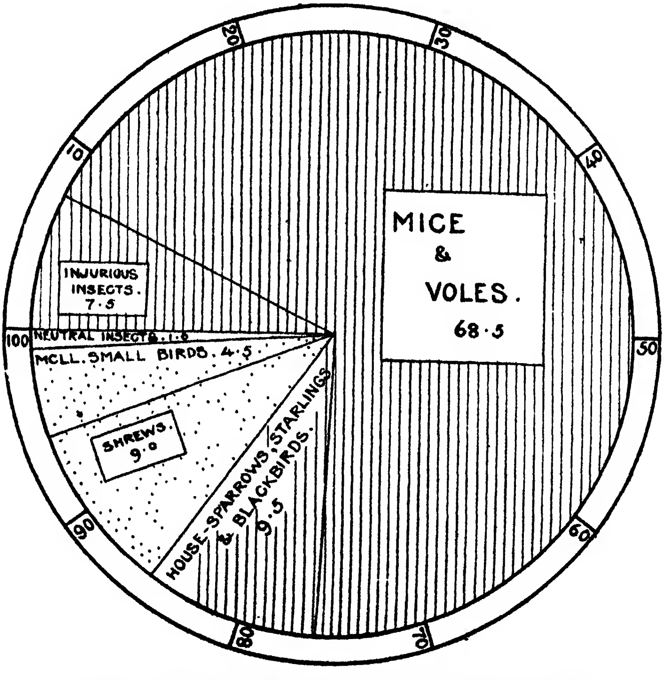

FIG. 2.—Diagram showing percentages of food consumed.

The call " is a loud, harsh, and most weird-sounding shriek which is more frequently uttered during the pairing season than at any other time; and early in the evening, when the bird commences its nocturnal peregrinations, the cry is most often heard."

Its eggs, 3 to 6 in number in a clutch, are laid at intervals of indefinite duration, and several broods are reared in the year, from the middle of April onwards. The eggs are pure white, somewhat dull, without any gloss, and slightly elongated.

Practically every investigator who has inquired into the feeding habits of the Barn-Owl has acclaimed it as one of the birds most beneficial to the farmer and landowner; it is therefore to be

greatly regretted that others should endeavour to besmirch its character and destroy it.

An analysis of the stomach contents shows that the food consists entirely of animal matter. Of the total bulk consumed 68.5 per cent. is composed of mice and voles, 9.5 per cent. of small birds (house-sparrows, starlings and blackbirds), 7.5 per cent. of injurious insects, 9 per cent. of shrew mice, 4.5 of small birds (finches, etc.) and 1 per cent. of neutral insects. The bird is beneficial in regard to 85.5 per cent. of its food (Fig. 2).

The enormous percentage of mice and voles destroyed at once draws attention to the benefit that this bird confers on the farmer, and even if there is any truth in the charges which have been brought against it in recent years of occasionally taking young game birds, the percentage of any such food is infinitesimal when compared with the remainder. It has frequently been pointed out that when the Barn-Owl is abroad seeking its food, all young game birds are safe beneath their mothers' wings.

Adams* has recorded that in 1,124 pellets he found remains of 2,407 rats and mice, of which, however, 169 were shrew mice.

In the writer's examination of 110 pellets it was possible to identify the following:—

Mole	5
Short-tailed Field Mouse (Field Vole)	62
Bank Vole	34
Long-tailed Field Mouse	149
House Mouse	25
Common Shrew Mouse	64
Brown Rat	125
House Sparrow	122
Blackbird	11
Starling	12
Thrush	5
Other small birds	17
Frog	4
Cockchafer, remains	81
Dung and other Beetles, remains	53
	769

Apart from the common shrew mouse, the frog and the dung beetles, and certain of the birds, the destruction of this food is a distinct gain to the farmer. Moreover, in none of these pellets was any trace of game birds found.

We must have thousands of Barn-Owls in this country and it would not prove any great task to obtain many thousands of pellets.

* *Journ. N'hamptn. N.H. Soc.*, 1913, p. 63.

The above mentioned 410 pellets contained of rats, mice and voles alone 395 specimens. Let us suppose that in 300 different localities two pellets were obtained daily for a year. On the basis of the above examination 219,000 pellets would account for the destruction of about 210,000 rats, mice and voles, and this is actually what is taking place all over the country. Yet it seems certain that the fact is not realised by farmers and others.

During the past eighteen months numerous complaints have been received stating that farm vermin have not been so plentiful for many years past. In some districts vermin have increased almost to the dimensions of a plague. The pecuniary loss to the farmer and to the nation generally can only be reckoned in millions of pounds sterling. Surely it is not too much to ask that the numerous agricultural societies and farmers' clubs should interest themselves in a matter so intimately related to their calling. Much also might be done in our rural schools to educate the rising generation on such matters.

In the interests of farmers and the community in general it is certainly high time that a species of wild bird of such great utility as the Barn-Owl should be most strictly preserved. In spite of statements to the contrary both the birds and their eggs are destroyed and this will continue until much more severe penalties are exacted.

NOTES ON MANURES FOR JANUARY.

E. J. RUSSELL, D.Sc.,
Rothamsted Experimental Station.

Another Waste Lime.—In connection with the previous references in these notes to waste lime a correspondent sends the following particulars of a "dried waste mud" which he is able to obtain from a paper works. Its composition is:—

Moisture	11·9 per cent.
Calcium carbonate	83·3 ,, ,,
Free lime (CaO)	1·9 ,, ,,
Caustic soda (NaO_2)	0·09 ,, ,,
Small stones and clinker	2·9 ,, ,,

He proposes to use it on rough pasture land in Derbyshire at the rate of 4 tons to the acre.

The sample is quite suitable for use and the rate of dressing is sound, but the value of the material would depend on the ease

with which it can be spread. If it were dry and in fine powder it would be worth about three-quarters the price of good ground limestone: it is not, however, in so good a condition. It has to be spaded out, but as the frost will cause it to disintegrate this is no drawback: at about one-quarter the price of ground limestone the material would be worth having.

A Northern Town Refuse.—The Superintendent of the Cleansing Department, Gateshead, sends the following particulars of the fertiliser made by the town authorities from the refuse. The tins, bottles, glass, and similar materials are removed: stable manure, slaughterhouse refuse and earth-closet material are added, and the whole passed through a preliminary machine and broken up to pass through a 5/8 grate. As 90 per cent. of the houses in Gateshead are of the old earth-closet type the house refuse contains a considerable proportion of human excrements: it is not surprising therefore that the manure finds a ready sale.

The material is delivered in 5-ton lots, and on a farm 5 miles away the price works out to 5s. 6d. per ton, the steam wagons taking the material where possible into the actual field which is to be treated. It has given good results on roots, and it improves the physical texture of the soil, though it still remains to be seen whether the material lasts as well as farmyard manure. On the farm in question farmyard manure is estimated to cost 14s. 2d. per ton.

It cannot be assumed, however, that all town refuse is as good as this. Towns on the water system have less valuable material to dispose of, and farmers should not buy until they know just what it is likely to be worth to them.

Green Manure.—In view of the necessity for increasing the supplies of organic matter in the soil, a correspondent in East Kent sends the following account of a method he has tried with advantage. He sowed red clover in a crop of wheat, but instead of letting it stand for hay he ploughed it in after harvest. On another part of the same field trefoil was similarly sown in the wheat and afterwards ploughed in. A third portion was seeded with rye grass, and the rest of the field was left in wheat only. After ploughing in the green crops oats were sown. Red clover and trefoil both produced a marked improvement in growth, as one would expect. It might be urged that this use of red clover would be prejudicial to the sowing intended for seeds hay as increasing the risk of clover sickness. This objection probably would not apply to trefoil; and as the seed is cheap the gain to the oat crop was a profitable one.

A method used with success on light land in the Lothians is to sow in the wheat in April 1¼ bushels Italian rye grass and 2 lb. red clover per acre. This mixture of seeds costs 11s., has made good growth at harvest and continues growing well afterwards. The crop is grazed until the end of January and then ploughed in for oats. As a heavy oat crop is desired this receives a top dressing of 1 cwt. of sulphate of ammonia per acre.

Basic Slag; should it be High Soluble or Low Soluble?—In days before the War farmers were always urged to purchase only high soluble slag, and the grades sold by the best firms had a solubility of 80 per cent. and upwards. During the War the process of manufacture changed and it is an open secret that the experts are no longer so much in agreement as they were in regard to the desirability of a high soluble slag.

Experiments have been initiated to obtain more definite information, and until these are completed it is not possible to lay down precise rules for the farmers' guidance.

In the meantime it is wise to assume that a high soluble slag will usually come into action more quickly than one of low solubility, and that a larger return may therefore be expected in the first season. It is possible, however, that in later seasons the low soluble slag may grow in effectiveness, and at the expiration of five years there may be little difference between the two; in some experiments, *e.g.* in Essex, this is clearly demonstrated. Until more definite evidence is forthcoming perhaps the safest assumption the farmer can make is that high soluble slag may pay him interest on his outlay almost from the beginning, while the returns from low soluble slag may be deferred.

Use of Artificial Fertilisers for Barley.—An interesting experiment was made last season to ascertain the effect of fertilisers on barley when grown in the usual way in rotation. Many farmers do not give artificial manure to their barley for fear it should go down or suffer in malting quality. The risk of lodging is of course real, but it can be minimised by the use of a stiff strawed variety such as "Plumage Archer." In some cases barley responds to superphosphate, which causes no lodging, but in the writer's experience the fear of nitrogenous fertiliser is often unnecessary. The following trial was made on the Stackyard or Sheepcote Field at Rothamsted, the barley being grown in the ordinary way of cropping, and following wheat. The yields were:—

	Grain per Acre: Head Corn. bushels.	Tail Corn. lb.	Straw per acre. cwt.	Weight of Corn per bushel. lb.	Grain to 100 of straw.
No manure	27·5	103	17·3	55·0	83·4
Superphosphate only (200 lb. per acre) ...	27·2	128	17·6	55·7	82·8
Superphosphate (200 lb. per acre) + Sulphate of Ammonia (112 lb. per acre)	37·4	160	24·2	55·5	82·6

The dressing of superphosphate and sulphate of ammonia has given an additional 10 bushels of head corn, ½ cwt. of tail corn and 7 cwt. of straw over that yielded by the unmanured. The weight per bushel of corn was heavier also.

The Distribution of Manures over the Rotation.—In most field experiments the effect of the manure is tested on one crop only, no notice being taken of the remaining crops. In practice, however, these other crops are a serious consideration and farmers frequently ask how best to distribute their manures over the rotation.

There are still farmers who put all their manures on to one crop and apply nothing in the rest of the rotation. This is justifiable only in special cases, *e.g.* in early potato farming. In the early potato district on the Firth of Forth the potatoes alone receive manure and not the rye or rape that comes in between. In an ordinary four- or five-course rotation it is a mistake to confine the manure to one crop only, even when the aftermath of the " seeds " is fed off.

An interesting experiment on this subject has been going on for some years in the Back House Field at Cockle Park. The soil is light and the rotation is swedes, barley, hay, oats. Some of the best results were obtained by dung alone for swedes (10 tons per acre), followed by artificials alone for hay (1 cwt. sulphate of ammonia, 5 cwt. superphosphate, 1 cwt. muriate of potash per acre). Nothing better was obtained in any of the various ways of dividing up the manures.

At Cockle Park a dressing of phosphate so increases the clover in the seeds hay that no nitrogenous top dressing is necessary for the subsequent corn crop. In cases where this good development of clover is not obtained, however, the cereal crop would need a top dressing.

Use of Potassic Fertilisers for Potatoes.—During the current season some interesting results have been obtained at Rothamsted showing the effect of potassic fertilisers in a severe drought. It was found that potash had a marked effect in the absence of dung, but only little action in its presence. All the

yields were low, but they were somewhat above the county average of 3 tons per acre.

	No artificial manure.		Superphosphate + sulphate of ammonia.		Potash + superphosphate + sulphate of ammonia.	
	tons	cwt.	tons	cwt.	tons	cwt.
No farmyard manure ...	1	17	1	7	3	15
Farmyard manure added	3	7	3	13	3	16

Although all these crops involved a financial loss owing to the drought the dressing of potash in absence of farmyard manure makes a considerable difference in reducing the loss. The experiment indicates that wherever farmyard manure is running short a dressing of potash should be given.

No significant difference was revealed in these experiments between sulphate of potash and sylvinite or French kainit, but the season was not favourable for testing points of this nature.

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NOTES ON FEEDING STUFFS FOR JANUARY.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Ministry of Agriculture.

Feeding Potatoes to Live Stock.—In several districts potatoes have fallen to a price at which it pays the grower to feed them to live stock rather than sell them. Several correspondents have asked for information on feeding potatoes, and a few practical points are given here.

Horses.—With regard to horses potatoes may be fed either raw or cooked in amounts up to 17 lb. a day.

Cows and Fattening Bullocks—With regard to cows or fattening bullocks, up to 28 lb. per head per day may be fed with safety. These amounts represent the maximum. If fed in excess of these quantities digestive disturbances arise.

Pigs.—In the case of pigs the main question that arises is whether the potatoes should be fed cooked or in a raw state. For breeding stock and store stock, potatoes may be fed raw with safety. Only in the case of small pigs is it necessary to cook potatoes before feeding.

The above remarks refer in all cases to potatoes of good quality. Care should always be taken to avoid the "greening" of potatoes, since green potatoes develop a bitter principle which makes them very distasteful to stock. In the case of

diseased and frosted potatoes steaming or cooking should be adopted if it is desired to feed them.

Maize Gluten Feed.—This fairly cheap nitrogenous feeding stuff is at present on the market, and several correspondents have asked for information as to its feeding value. Maize gluten feed consists of a mixture of the by-products obtained in the manufacture of maize starch and can be regarded as the maize grain with most of the starch removed. It is rich in oil and protein and is well suited for dairy and fattening stock. This feeding stuff has been included in the table in order that *Journal* readers may obtain some idea of its relative value for feeding.

The Mineral Requirements of Pigs.—Owing to the nature of their diet, pigs are very often fed on foods deficient in the ash constituents that are necessary if they are to remain in good health and grow satisfactorily. Such substances are roots and maize products. This deficiency will also occur where pigs are kept on the open-air system on light land farms. On American Agricultural Experimental Stations, much attention has been paid to the question of the mineral requirements of pigs, and experiments have been undertaken, particularly at the Iowa Experiment Station, under the direction of Professor Evvard. As the result of many experiments the following mixture has been suggested tentatively as a suitable complete mineral mixture for pigs :—

	lb.
Salt, common, flake form	30·0
Spent bone black, or bone meal, finely ground or bone flour	25·0
Commercial kainit, or potassium chloride, or wood ashes ...	12·0
Sulphur, flowers of	10 0
Air-slaked lime, or limestone, finely ground	10·0
Glauber's salts or sodium sulphate	5·7
Epsom salts or magnesium sulphate	5·0
Copperas, or iron sulphate	2·0
Potassium iodide	0·3
	100·0

This mixture does not represent the final word on the subject, and the station is still engaged in putting experimental knowledge to practical test. Pig feeders, however, will probably find that the use of this mixture will help to condition their pigs and keep them in good growing condition. About 1 lb. per month per adult pig is the suggested allowance when hand-fed. For those who wish to have a fairly simple mineral

—	Price. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	50/-	504	11 2	1 17	9 5	71·6	2/7	1·38
Barley, English Feeding	36/9	400	10 6	1 6	9 0	71	2/6	1·34
" Canadian "	34/0	400	9 10	1 6	8 4	71	2/4	1·25
Oats, English White "	32/9	336	10 18	1 9	9 9	59·5	3/2	1·70
" " Black & Grey	30/-	336	10 0	1 9	8 11	59·5	2/10	1·52
" Argentine	28/-	320	9 16	1 9	8 7	59·5	2/10	1·52
Maize, "	36/-	480	8 8	1 5	7 3	81	1/9	0·94
" Gluten-feed	—	—	9 10	2 15	6 15	75·6	1.9	0·94
Rye, English	43/6	504	9 13	1 8	8 5	72	2/4	1·25
Millers' offals—Bran	—	—	9 10	2 10	7 0	45	3/1	1·65
" " Coarse middlings	—	—	11 10	2 10	9 0	64	2/10	1·52
Barley meal	—	—	13 0	1 6	11 14	71	3/4	1·78
Maize "	—	—	8 17	1 5	7 12	81	1/11	1·03
Fish "	—	—	16 10	7 12	8 18	53	3/4	1·78
Linseed	—	—	17 10	2 16	14 14	119	2/6	1·34
" Cake, English (9°/o oil)	—	—	14 5	3 12	10 13	74	2/11	1·56
Cotton seed " English (5°/o oil)	—	—	9 17	3 5	6 12	42	3/2	1·70
" " Egyptian (5°/o oil)	—	—	9 12	3 5	6 7	42	3/-	1·61
" " decorticated (7°/o oil)	—	—	14 0*	5 6	8 14	71	2/5	1·29
Palm kernel cake (6°/o oil)	—	—	7 15*	2 1	5 14	75	1/6	0·80
Brewers' grains, dried, ale	—	—	10 2	2 7	7 15	49	3/2	1·70
" " " porter	—	—	9 0	2 7	6 13	49	2/9	1·47
" " wet, ale	—	—	2 5	0 12	1 13	15	2/2	1·16
" " wet, porter	—	—	1 18	0 12	1 6	15	1/9	0·94
Malt culms	—	—	7 5	3 6	3 19	43	1/10	0·98
FARM VALUES.	—	—	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	S.E. per 100 lbs.	Value per s.	Market Value per lb. S.E. d.
Potatoes	—	—	1 19	0 8	1 11	18	1/9	0·94
Swedes	—	—	0 17	0 5	0 12	7	1/9	0·94
Mangolds	—	—	0 17	0 6	0 11	6	1/9	0·94
Good Meadow Hay	—	—	6 12	1 14	4 18	31	3/2	1·70
Good Oat Straw	—	—	3 11	0 17	2 14	17	3/2	1·70
Good Clover Hay	—	—	7 3	2 2	5 1	32	3/2	1·70
Vetch and Oat Silage	—	—	2 10	0 15	1 15	14	2/6	1·32

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

mixture which supplies the main essential elements, equal parts by weight of air slaked-lime and salt, or of wood ashes and salt will prove suitable.

Mineral deficiency in pigs is generally shown by the pigs developing a "staring" coat and a tendency to go down at hindquarters. In severe cases the condition of complete paralysis may occur. The effects produced are very similar to those experiments when diets deficient in vitamines are fed.

A Simple Method of obtaining the Nutritive Ratio of Mixed Rations.—Correspondence in the agricultural papers recently suggests that feeders often have great difficulty in ascertaining the nutritive ratio of a mixed ration. The nutritive ratio of a ration shows the proportion existing between the digestible protein of a ration and the digestible non-protein substances. Thus, the nutritive ratio of 1 : 6 indicates one part of digestible protein to 6 parts carbohydrate equivalent.

From a table of composition of feeding stuffs giving the digestible protein and the nutritive ratio of the separate substances, it is quite easy to calculate the nutritive ratio of any mixed ration. The method is as follows:—Ascertain the amount of digestible protein present in each ingredient in the ration and multiply this by the nutritive ratio to get the carbohydrate equivalent. Do this for each ingredient in turn, add the digestible protein figures together and also the figures obtained by multiplying by the nutritive ratio, divide this second figure by the first and this will give the nutritive ratio of the ration. A concrete example will illustrate the method:—

Ration.	*Dig. Crude Protein.*		*Carbohydrate Equiv.*	
4 lb. Linseed Cake ...	contains (4 x ·253) =	1·01	and (1·01 x 2) =	2·02
50 lb. Mangolds ...	„ (50 x ·007) =	·35	„ (·35 x 13) =	4·55
10 lb. Meadow Hay	„ (10 x ·054) =	·54	„ (·54 x 8) =	4·32
		1·90		10·89

$$\text{Nutritive Ratio of Ration} = \frac{10\cdot89}{1\cdot9} = 1 \ : \ 5\cdot6$$

Any other ration may be worked out in a similar manner.

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Seventh Meeting of the Council of Agriculture for England was held on 6th December last, at 2.30 p.m., at the Middlesex Guildhall, Westminster, S.W.1, Sir Douglas Newton, K.B.E., being unanimously elected to the Chair in the absence of Lord Selborne abroad. The Minister of Agriculture was present throughout the proceedings.

The question of the draft regulations for the Voluntary Registration of Bulls was considered. The scheme embodied in the regulations had been drawn up by the Live Stock Advisory Committee of the Ministry and arose out of a reference which the Council had made to that Committee of a resolution which had been proposed at its Meeting of 4th March last by Sir Merrik Burrell. Sir Merrik Burrell suggested an amendment of Clause 1, which was not accepted by the Council, and after further discussion, in which the Minister took part, it was agreed that the draft regulations should be referred back to the Agricultural Advisory Committee.

Lt.-Col. H. E. Disbrowe-Wise moved:—

> "That the Council recommend the Ministry to promote legislation on the lines of Section 10 of the Corn Production Act, 1917, recently repealed, with the object of enabling the Agricultural Committees to deal with the rabbit pest in cases where damage to crops is sustained by the attacks of vermin from adjoining occupations."

The mover said that it had been argued that the tenant farmer had the remedy in his own hands, as he could kill or trap or net rabbits. He could not, however, enter anyone's land in order to destroy them. Colonel Disbrowe-Wise thought that difficulty usually arose when the owner of the rabbits was a shooting-tenant and not the owner of the land. Cases of this sort could generally be managed with a little diplomacy, but where that was not possible, the tenant had no remedy at law. He asked, therefore, that Section 10 of the Corn Production Act, 1917, should be re-enacted.

Lord Bledisloe, in seconding the resolution, said that strenuous efforts had been made to get the Section re-enacted in the last Agriculture Act, but without success. The grievance may not be a very real one at the present, but he was afraid it was likely to develop. There was the danger from shooting-tenants, who were often townspeople having no interest

whatever in farming and who allowed rabbits to increase unduly. He would strongly deprecate legislation which would allow a tenant farmer to enter woods abutting his farm in order to destroy rabbits, but it ought to be possible with the help of Agricultural Committees to frame regulations which would prevent such persons as he had described from being a real danger to farming property.

Mr. McCracken thought Railway Companies were great offenders and Mr. Donaldson supported the motion as one who had suffered from the depredations of the vermin. Mr. Acland said that in cases in Devonshire and Somerset which he knew, it was the landlord who was trying to put the rabbits down and the farmer who was trying to keep them up. He found that the increase of rabbits on his own property had enormously added to the expense of planting trees on account of the wire netting required. He thought the resolution a good one and deplored the fact that farmers frequently preferred sixpennyworth of sport to £6 of damage done by rabbits.

The Minister said that he fully realised the great damage done by rabbits and vermin. If the Council passed this resolution, the only way it could be carried out would be by legislation. He would be quite prepared, so far as he was concerned, to see that the legislation was introduced, but it would have to be quite clear that any money required to make it effective could not be found by the Treasury. A Rabbits Officer would appear to be required. He would ask the Council how the legislation would be carried out. The Cultivations Committee used to have a considerable staff of officers, but nearly all that staff had been disbanded. They did not want to see such an Act as was proposed become a dead letter, and it could only be prevented from becoming so by the expenditure of money. Would those who now supported this proposal also support in their respective Local Councils the expenditure of sufficient money to carry out the provisions of an Act?

Mr. Bruford suggested that the members of Agricultural Committees could deal with the matter voluntarily, or that the County Land Agents could take it in the course of their ordinary work. He did not think the County Councils would object to expending the small amount of money required. Mr. C. P. Hall and Mr. Hawk considered that means could be taken by which the cost would become negligible. Mr. Colin Campbell agreed with this view and Major Courthope, M.P., suggested that the jurisdiction of Petty Sessional Courts might be used without the appointing of any additional officers. He thought that the

resolution should refer to damage sustained on plantations as well as crops. Sir Merrik Burrell considered that any expense should be borne by the man who was responsible for the nuisance. Mr. Gardner suggested that the onus of clearing out rabbits should be placed upon occupiers and the County Councils given sufficient power to take legal action against offenders and have them fined.

It was then moved and seconded that the words "and plantations" should be inserted after the word "crops." This was agreed to and the motion was carried.

Mr. German inquired as to whether any payment would be made to small farmers in regard to fractions of acres which had not so far been allowed in the claims made by them in respect of their crops of wheat and oats during the past season. The Minister replied that the matter had been placed before the Law Officers of the Crown, who had advised that it would be illegal to pay on fractions of an acre and that no regulation which he could make could possibly give payment any validity. In the case where a man had several fields and his crops ran out to a fraction of an acre on each field, then the various fractions would be added together and paid for as acres, but it would be illegal to pay on the ultimate fraction. It was a hardship on the small man who grew less than an acre, but he had no other course open to him than to accept the Law Officers' decision. It was purely a legal question and unfortunately had not been raised while the original Act or the repeal Act was in passage through the House, or it might have been provided for in advance. The matter could not now be remedied by legislation which could not now be passed before Easter next at the earliest, when it would be impossible to check any claims that were sent in.

Mr. German suggested that the Law Officers had not stated that hedges and ditches should not be paid for and that it might be open for the Minister to include an allowance for these and so bring up the fraction to a whole acre. The Minister stated, however, that the legal view was that the area of hedges and ditches should be deducted as they form no part of the acreage of the crops.

Mr. Acland, speaking on the point of the matter not having been raised during the passage of the Bills, said that must have been because it could never have occurred to anybody that fractions of acres would not be paid for. It seemed to him to be one of the most amazing legal decisions he had ever heard and

he thought it should be put right by legislation. In his view it was an entirely illegal and absurd injustice to the small man and he believed that there ought to be enough money over or money voted by Parliament to enable these fractions to be paid for.

Mr. McCracken moved :—

"That in the opinion of this Council it is desirable that a carefully considered record should be prepared, so as to be available for reference in any future emergency, of the policy pursued in relation to Agriculture during the Great War; and that in order to prepare such record full investigation should be made, by such means as the Ministry in their wisdom think best, now, while the facts and circumstances are fresh in the memories of those most conversant with them, into :—

(1) The efficacy or otherwise of the various Orders made in securing the results desired.

(2) The administration and effect of those orders.

(3) Improvements in policy and procedure which careful consideration and experience gained may suggest."

He suggested that the carrying out of the motion would not involve any considerable expenditure. In any case it was essential that the inquiry should be conducted on anti-waste principles. The result should be historic in character. He instanced one or two cases of unfortunate policies which had been adopted during the War in which the existence of a careful record might prevent their recurrence at any future time. Mr. Colin Campbell seconded the motion, saying that he hoped the occasion would never arise in which to use the experience proposed to be recorded.

The Minister of Agriculture said that he was generally in sympathy with the objects of Mr. McCracken's motion and, as a matter of fact, considerable steps had already been taken to carry out what was proposed. Records had already been published in the Reports of the War Cabinet for the year 1917-1918 and in the proceedings of the Food Production Department. Sir Thomas Middleton, who had been principal officer of the Food Production Department, was publishing a book on Food Production as one of a series to be entitled "The Economic and Social History of the World War" to be issued by the Carnegie Trust. He suggested that the Council should await the publication of this book before asking the Ministry to take further steps. The motion was then put to the Meeting and carried.

Lord Strachie moved :—

"That it is desirable that a full report of all Meetings of the Council and of the Agricultural Advisory Committee should appear in the *Journal* of the Ministry of Agriculture."

The mover said that the reports of the meetings held in August and October covered hardly more than a page and a half in *The Journal of the Ministry of Agriculture*. There had also been an omission, the letter which the Minister had written to the chairman, Lord Selborne, which contained a reference to the embargo on store cattle, not having been printed in the *Journal*, and agriculturists had, therefore, not had an opportunity of seeing it. No increased cost in the publication of the *Journal* would appear to be necessary inasmuch as other matters could be, without much loss, left out of the publication. The terms of his resolution were not mandatory in any sense; all he wished was that the Council should express an opinion, leaving it to the better judgment of the Minister whether he thought it desirable to act on the suggestion. Mr. Colin Campbell seconded the motion.

The Minister said that he was quite prepared to agree to the publication of fuller reports of the Council's meetings in the *Journal* of the Ministry. He did not think that Lord Strachie meant that they should be inserted verbatim. If they were, they would fill the *Journal* to the exclusion of a great deal of most valuable matter. As to reports of the proceedings of the Agricultural Advisory Committee, that was, more or less, a confidential body which acted in the manner of a Cabinet, and it would be undesirable to publish its proceedings in detail. He thought, however, that the reports summarising its conclusions, one of which was now about to be submitted to the Council, should be printed in the *Journal*.

The motion was then put to the Meeting and carried.

Mr. E. W. Langford moved that the report of the Agricultural Advisory Committee should be received by the Council. (This Report is printed on p. 942 of this *Journal*.)

The Minister announced that in conformity with a suggestion which he had made in a letter to Lord Selborne on 4th October, 1921, a copy of which had been circulated to each member of the Council, he was prepared to make a statement to the Council at each of its statutory meetings which would cover a general review of the situation with regard to agriculture during the preceding six months. On the proposal of Mr. Donaldson, seconded by Mr. Colin Campbell, the offer was warmly welcomed by the Council and agreed to.

SECOND REPORT OF THE AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

SINCE 11th August last the Agricultural Advisory Committee has met twice, viz., on 12th October and 9th November, the following subjects having been dealt with at the meetings:—

(1) **Wart Disease of Potatoes.**—A Memorandum setting out the position with regard to this disease was considered, and it was decided that the planting of non-immune varieties of potatoes be allowed in areas scheduled as Infected Areas under the Wart Disease Order, though no such varieties are to be planted on land actually known to be infected with the disease. Additional restrictions are to be placed upon the movement of potatoes as follows:—(1) Potatoes of susceptible varieties which have been grown in any infected area so declared by the Ministry, the Board of Agriculture for Scotland, or the Department of Agriculture for Ireland, are not to be moved into any clean area; (2) If disease appears in any crop grown in England and Wales, the potatoes shall not be marketed except in a place mentioned in a licence granted by the Ministry; (3) Potatoes for planting shall not be sold anywhere in England and Wales unless the grower of them has obtained a certificate from the Ministry or from the Scottish Board, or the Irish Department, to the effect (*a*) that the potatoes are of an approved immune variety, true to type, and free from rogues, or (*b*) that the potatoes have not been grown in any infected area, and that Wart Disease has not been reported to have occurred on the holding on which the potatoes were grown.

(2) **The Allocation in England and Wales of the Proposed Grant of £850,000 for Promoting Agricultural Development.**—A Memorandum covering and explaining the proposed general lines of the allocation was considered, and a Sub-Committee was appointed to go into the details of the matter with the Ministry and to report again to the Committee. This Sub-committee has not yet presented its Report.

(3) **Telephone Facilities at Railway Goods Stations.**—The Council of Agriculture for England had at its meeting on 27th May, 1921, passed the following resolution:—

> "That in the opinion of this Council, all railway goods stations at which perishable produce is dispatched or received should be connected with the public telephone forthwith."

The Ministry had been furnished with a list of certain stations in important fruit and vegetable growing districts, and had written to the Ministry of Transport with regard to the resolution citing the cases of the particular stations named. The Ministry of Transport replied that it had taken up the matter with the Railway Company whose stations were named and that they had answered that whilst they realised that such telephones if fitted would serve a useful purpose they were not essential and that the Company were unable to take any further action in the matter.

The Committee considered that this reply was unsatisfactory, and that the question was one of general application and not confined to the particular Railway Company which had sent this reply. In view of the fact that the lack of telephones resulted in trucks not being available when required for urgent transport of perishable fruit and vegetables, and that markets were frequently missed and other losses incurred, the value of which would many times exceed the cost of the installation and maintenance of telephones, the Committee considered that some special steps should be taken. It was decided that the case should, in the first place, be brought by the Controller of Horticulture before an early meeting of the Interdepartmental Committee on Transport so that its observations may be available at the next meeting of the Agricultural Advisory Committee.

(4) **The Provision of Land Drainage Work for Unemployed.**—The Minister outlined this scheme in aid of which an allocation of £650,000 of the money which the Government had decided should be spent in the relief of unemployment, had been obtained for agricultural drainage work. Advances were to be made through Drainage Authorities and County Agricultural Committees, on condition that ex-Service men mainly were employed and that at least 35 per cent. of the money advanced be refunded to the State when the work was completed. The Minister had been unable to lay the matter before the Committee prior to the publication of the scheme as the work was urgent. Some 30 schemes had already been initiated in various parts of the country, and as soon as they were formally approved they would commence.* No unnecessary formalities would be allowed to stand in the way of work under the scheme being at once started. The scheme was formally approved by the Committee.

* See also p. 922.

(5) **Report of the Royal Commission on the Importation of Store Cattle.**—The Minister opened a discussion upon this subject, though he said that he would not ask the Committee for their final views until they had had an opportunity of consulting the Minutes of Evidence which were not yet published. After some expression of views by the members of the Committee, the discussion was adjourned, pending publication of the evidence, and in view of the special meeting of the Council of Agriculture for England on 22nd November (see this *Journal*, December, 1921, p. 772).

(6) **Committee on Credit Facilities for Farmers.**—In accordance with the Resolution passed in the following terms by the Council of Agriculture for England at its meeting on 4th October, 1921 :—

> "That in view of the sudden and drastic alteration made by the Government in their agricultural policy, they are hereby respectfully requested to make provision for advances on loan, in approved cases of working capital, to farmers who have recently purchased their holdings, on similar lines to those followed in the case of small-holders, and that the Agricultural Advisory Committee should be asked to appoint a Special Committee of members of this Council to consider whether a sound system of credit can be devised for submission to the Government,"

a Preliminary Committee was set up by the Advisory Committee to consider the personnel of the Special Committee and its terms of reference. This Preliminary Committee recommended that the Special Committee should consist of Sir Douglas Newton, Mr. E. W. Langford, Mr. John Roberts, Mr. G. G. Rea, and Mr. W. R. Smith, M.P., members of the Council, with the addition of Mr. R. Holland Martin, Secretary of the Bankers' Clearing House, and Sir Anker Simmons, Auctioneer and Estate Agent, as co-opted members; and that its terms of reference should be :—

> "To consider and report whether in the interests of maintaining production, and to promote employment on the land, it is desirable to revive or to extend the scheme of providing short term credit for farmers which was in operation during the War."

The Preliminary Committee stated that it had carefully considered the scheme referred to in the suggested reference and was of opinion that a scheme on similar lines would probably meet the needs of the present case, and that any such scheme should be limited to the supply of working capital.

(7) **Exportation of Artificial Fertilisers.**—It was suggested on behalf of the Ministry that the restrictions on the exportation of artificial fertilisers, which were the result of special conditions created by the War, should be finally removed. An Order in Council under the Fertilisers (Temporary Control of Export) Act, 1920, prohibited the export of sulphate of ammonia, superphosphate, basic slag, and compound manures containing any of them, except by licence of the Board of Trade. An open general licence had already been issued authorising export of sulphate of ammonia. The position in regard to superphosphate and basic slag was carefully considered, and it was decided that the position should be reviewed again at the next meeting.

(8) **Landing of Hay and Straw from France.**—The French Government had requested the British Government to permit once more the landing of hay and straw from France. The prohibition had begun in 1908 and all hay and straw (except that actually used as packing for merchandise, or manufactured straw not intended for use as fodder or litter, or hay and straw permitted to be imported by licence for use afterwards as fodder and litter for animals) was prohibited unless it came from Australia, Canada, South Africa, New Zealand, U.S.A., Norway, Channel Islands, and the Isle of Man. The Committee considered the matter and agreed that some further enquiries should be made as to the restrictions which France enforced against the produce of this country.

(9) **R.S.P.C.A. proposed Bill to order the Slaughter of Horses Rejected as Unfit for Export.**—The details of this proposal were considered at the meeting, and it was decided that the present powers of the Ministry under the Exportation of Horses Act, 1914, were sufficient to meet the needs of the case, and that it be recommended that the Minister's approval of the proposed Bill be withheld.

CONCILIATION COMMITTEES IN AGRICULTURE.

THE total number of Conciliation Committees which have been established under the Corn Production Acts (Repeal) Act, 1921, has now increased to 57; of these 39 have made agreements as to wages. In certain cases some of these agreements have temporarily lapsed, though meetings are being held with a view to making agreements for a further period. Details of the agreements in operation at the end of last month were published in the December issue of this *Journal*, and particulars of further agreements since arrived at are given below:—

Area.	*Period.*	*Wages.*	*Hours per week.*
Essex	Up to 31st Dec., 1921	9d. per hour on weekdays. 1s. per hour on Sundays.	—
Hampshire	" 14th Jan., 1922	36s. 0d.	48
Lancashire:—			
Southern Area	" 31st Dec., 1921	45s. 0d.	Usual working hours.
Northern "	" 31st " "	47s. 6d.	" "
Eastern "	" 31st " "	50s. 0d.	60
Leicester:—			
Melton Mowbray and District	" 31st " "	36s. 6d.	50
Middlesex:—			
South-West	" 28th Jan., 1922	9½d. per hour on weekdays. 1s. per hour on Sundays.	50, with guaranteed week of 48 hours.
Nottinghamshire	" 31st Dec., 1921	38s. 0d.	50
Rutlandshire	" 31st Jan., 1922	34s. 0d.	48
Monmouthshire	" 31st Dec., 1921	38s. 0d.	48
Cardiganshire	" 28th Feb., 1922	36s. 0d.	50
Glamorgan	" 31st Dec., 1921	40s. 0d.	50
Merioneth		35s. 0d.	50
and Montgomery	" 31st Jan., 1921	38s. 0d.	56

The rates in the majority of cases apply to "adult male workers," the Committees apparently relying on Clauses 11 (a) and (b) of the Act to cover the special cases of workers who are affected by some mental or physical disability. In a few areas the Committees have stipulated that the rates shall apply only to workers of "fair average ability," while in two cases a further clause has been inserted providing that the recommended rates should affect only those workers of the classes mentioned "who are regularly employed in agriculture."

In the majority of instances the Committees have confined their recommendations to adult male workers, and have not so far dealt with the question of wages for workers under 21, which for the time being are left to be settled by mutual agreement between worker and employer. In the following areas, however, the Committees have agreed on rates for juvenile male workers:—Cornwall, Cumberland and Westmorland, Devon, Durham, Isle of Ely, Hertfordshire, Kent, Leicester—Bosworth Ashby, Melton Mowbray, Market Harborough, Northamptonshire, Nottinghamshire, Soke of Peterborough, Shropshire, Somerset, Warwick, Yorkshire—North and East Ridings, while in the following areas rates have been agreed on for certain classes of female workers:—Cumberland and Westmorland, Devon, Durham, Hertfordshire, Kent, Nottinghamshire, Yorkshire—East Riding. It should be mentioned that in several of these areas the agreements having been made for comparatively short periods have now lapsed.

The principle of fixing valuations for the provision of "allowances" made by employers to workers as part payment of wages has been adopted by certain of the Conciliation Committees. In Wales where the "living in" practice widely applies the Committees seem especially to favour this course and have in almost every case fixed a value for board and lodging. A cottage valuation has also been adopted by several Committees.

Redemption of Tithe Rentcharge: Search Charges.

IT frequently happens that landowners who desire to redeem the tithe rentcharge charged on their properties experience considerable difficulty in ascertaining the exact amount of the tithe rentcharge to which their lands are legally liable. In some cases the statutory parish copies of the tithe apportionment and map have been damaged or lost. In other instances the property in respect of which redemption is desired may extend into a number of different parishes, townships, hamlets or tithings, for each of which there is a separate tithe apportionment and map, so that the landowner who obtains, locally, particulars of the tithe rentcharge on his property, may be put to the trouble and expense of searching documents deposited at a number of different places in the custody of a number of different people.

With a view to assisting in such cases, the Ministry (3, St. James's Square, London, S.W.1) has made arrangements for supplying details of the tithe rentcharge charged on any property on being furnished with a plan, preferably on a $\frac{1}{2500}$ scale Ordnance Sheet, with the existing boundaries of the property clearly and accurately defined thereon by an edging of colour. For this service a uniform search charge will be made amounting to 5s. if the property does not exceed 10 acres, 10s. if it exceeds 10 acres but does not exceed 30 acres, and a further 5s. for every additional 30 acres or part of 30 acres, irrespective of whether one or more tithe apportionments and tithe maps may have to be consulted. For example, the cost of supplying details of the tithe rentcharge on 300 acres of land will be 10s. plus nine times 5s., that is, £2 15s.

Pig-Feeding Experiments.

The Value of Whey in Feeding Pigs.—Experiments have been carried out recently at Reading University College Farm to determine the value of whey in feeding pigs, and it has been demonstrated that pigs fed on whey and whey constituents, and having access to grass, will thrive to a much greater degree than those kept under the usual sty conditions and fed on swill, etc., both in regard to appearance and quality of their flesh. These experiments suggest that whey contains an insufficiency of fat-soluble vitamine A. to allow excess for storage in the fat. and that grass or green food makes up for the deficiency.

Results show that young pigs fed on grass and toppings for a period of 84 days increased on the average 49 lb. in live weight, whereas similar pigs fed with whey, grass and toppings for the same period made an average live weight increase of 72 lb.

These experiments tend generally to substantiate what has for a long time past been the opinion of cheesemakers throughout the country—namely, that very considerable advantage can be gained by the feeding of whey to pigs.

Pigs and the Fat-Soluble Factor.—Another experiment at Reading University College Farm has recently been carried out with the object of ascertaining the influence of the fat-soluble factor on the growth of pigs. Four animals were employed, divided into two groups. Group 1 was placed on a diet containing the fat-soluble factor, and Group 2 was kept on a diet rigorously restricted in that factor. The test was carried out over a period of five months, and further experiments are in progress.

The results so far obtained are as follows:—

(1) No definite rickets were induced in sucking pigs fed from birth on a diet rigorously restricted in the fat-soluble factor.

(2) The addition of the fat-soluble factor in the form of cream, cod-liver oil and lucerne to a deficient diet stimulated growth in pigs declining in weight.

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Crop Reporting, and the Collection of Agricultural Statistics.

IN the House of Lords on 3rd November last, Lord Strachie raised the question of the need for crop reports, and asked what was the number of crop reporters, and what was the cost of crop reporting during the past financial year compared with the last financial year before the War. In dealing with the whole question the Earl of Ancaster, Parliamentary Secretary of the Ministry of Agriculture and Fisheries, replied as follows:—

The answer to the noble Lord's Question asking for these particulars is that the number of crop reporters in the year 1913-14 was 220, and in 1920-21, 336. The amount voted for crop reporting in the earlier year was £3,600, and the actual cost £3,137; in 1920-21 the amount voted was £36,500 and the actual cost was £34,117. The increase in the cost since 1913-14 was mainly due to the fact that in the earlier period the Annual Agricultural Returns were collected by the Customs and Excise. The actual cost of the work to the Customs and Excise in 1913-14 is not known. It was all taken as a block Vote, and the only information we can give on that point is that about thirty years earlier the annual cost was estimated at £11,800; but since 1890 no special provision has been made in the Vote for the work done by the Customs or Inland Revenue under this head, as it has been lumped in with other services. There has been, however, no material change in the character of the work between 1913-14 and 1920-21, and although it is probable that it is more efficiently done under the present system, it may be taken as certain that the collection of the Annual Returns is not more costly than if they were still being collected by the Customs.

The transfer from the Customs was made in consequence of the increased duties placed upon that Department in other directions, and was authorised by the Treasury in 1919, the work relating to these Annual Returns being undertaken from that time by part time officers of the Ministry, known as crop reporters. That is to say, crop reporters, after that time, had to furnish the Annual Agricultural Returns which, up to that time, had been furnished by the Customs. These officers, who received in the aggregate £3,600 in 1913-14 and £5,325 in 1915-16, when other duties were cast upon them, were considered to be underpaid. I think they were complaining that they did not receive enough money, and when this additional work was placed upon them, their remuneration was increased, partly in respect of the new work, and partly in respect of their previous duties.

These persons who, as I have said, number 336, are usually land agents, land valuers, or other persons possessing a knowledge of agriculture in the districts with which they deal. They are paid by fees averaging about £100 per annum, but varying according to the size of the district allotted to them. When the heavy work previously done by the Customs was taken over in 1919, it was considered that this work could only be done efficiently by creating smaller districts than those which had hitherto been used for the Ministry's crop reporting; hence the number of reporters was increased from 220 to 336. The work consists of:—(*a*) The collection annually of a Return of the area under crops and the number of live stock on holdings of more than one acre; (*b*) the estimation of the production of the principal crops; and (*c*) the supply to the Ministry of a monthly report on the condition of crops and agricultural conditions generally. In addition the crop reporters supply special information as required.

The value of these Returns cannot be questioned. They are the basis of all discussions on agricultural policy, and afford the only real measure of the dimensions of the industry, the changes in cultivation, the number of live stock, the yield of crops, and other questions of primary importance from an economic point of view. I may say that this question has been carefully gone into by the Ministry, and I think it is very doubtful indeed if any possible economy can be made in this direction, if the information that is now obtained is still desired. Of course, it is a question of policy, and perhaps a very proper question for the Agricultural Council, or some body like that, to state whether these Returns and crop reports need be so full. There is now, as the noble Lord knows, a monthly crop report, but I may say that the Department have examined it very closely, and that it is certainly the general opinion of the Ministry that these reports should be as full and the statistics as careful and as well-informed as they now are. I am afraid it is very doubtful indeed, in fact impossible, that the expenditure upon them can be cut down to any large extent.

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AGRICULTURE ABROAD.

LIVE STOCK IN ARGENTINA—DAIRY PRODUCE IN CANADA.

THE annual Live Stock Exhibition organised by the Argentine Rural Society took place at Buenos Aires in September. As in previous years, the awards were made by judges specially invited from the United Kingdom.

Live Stock Exhibition in Argentina.

Shorthorns were again the chief feature of the Exhibition both in the high standard of the exhibits and in the number of entries. The Hereford classes, which have done so much towards the success of the cattle-raising industry in the Argentine, were well represented. A distinctive feature was the display of Aberdeen-Angus cattle, which received much favourable comment; the growth of this breed in Argentina during the past few years has been remarkable both in numbers and in quality. In view of the great advance which the dairying industry is making in the Argentine, considerably more interest was shown at this year's Exhibition in dairy cattle.

There were some exceptionally good specimens of the various breeds of sheep and pigs. Although the expansion of the motor industry has been detrimental to horse-raising generally, some good specimens of the Shire and Clydesdale classes were exhibited. The French breeds were well represented, as also were Hackneys and other light breeds, but the reduction in entries reflects the diminished interest in carriage horses.

The sales of exhibits were disappointing to exhibitors on account of the low prices realised, which were 40 per cent. below those of last year's Exhibition. This fall in prices is attributed to unfavourable conditions in the Argentine; there has been a serious drought, resulting in a scarcity of pasture and a general fall in the prices of cattle.

In opening the Exhibition the Argentine Minister of Agriculture referred to the effects of the War on the stock-breeding industry, and emphasised the futility of expecting to maintain in times of peace the inflated prices which ruled during the War. He maintained that future prosperity lay in high quality, and urged the value of good selection in the purchase of breeding stock.

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The Grading of Dairy Produce in Canada.

THE importance of grading dairy produce for sale has for some time been clearly realised in Canada, where a system of grading has been carried out under both Federal and Provincial authorities, as well as by other bodies, both official and unofficial. The object of this grading has in some cases been mainly educational, while in others the aim has been purely commercial, but the system hitherto has been conducted on a voluntary basis and has had no legislative authority behind it.

During the 1920 session of the Canadian Parliament, a resolution calling upon the Government to establish a grading system was introduced into their House of Commons. The unanimous support of the members was accorded, and the Minister of Agriculture, in accepting the principle of the resolution, said that he would be prepared to carry out a scheme of grading for dairy produce as soon as the producers were ready for the introduction of such a system.

It would appear that the dairy producers must have afforded speedy evidence of their desire for Government action in this matter, for an Act, " to regulate the grading of dairy produce," cited as the Dairy Produce Act, was passed by the Canadian Legislature on 4th June, 1921. The Act empowers the Governor in Council to make regulations for the grading of dairy produce intended for export, the articles enumerated being " butter, cheese and other food products manufactured from milk." It also provides for the appointment of official graders, and for the establishment of standards, definitions, grades and grading stores for dairy produce and the imposition of fees for the grading. The graders are to be empowered to issue certificates as to the quality and proper classification of any dairy produce which they have examined for the purpose. Fines of from 50 to 200 dollars, or imprisonment for a term not exceeding 3 months, may be imposed for contraventions of the regulations issued under the Act.

The value of the Act in promoting the standardisation of Canadian dairy produce intended for export and in discouraging the production of an inferior article can hardly be over-estimated, and it would be well if the importance of this progressive step could be clearly brought home to every British dairy farmer.

AGRICULTURAL RETURNS, 1921.

PRODUCE OF POTATO AND ROOT CROPS IN ENGLAND AND WALES.

PRELIMINARY STATEMENT showing the Estimated Total Produce and Yield per Acre of the POTATO and ROOT CROPS in England and Wales in the Year 1921, with Comparisons for 1920, and the Average Yield per Acre of the Ten Years 1911-1920.

—	Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1911–20.
		1921.	1920.	1921.	1920.	1921.	1920.	
		Tons.	*Tons.*	*Acres.*	*Acres.*	*Tons.*	*Tons.*	*Tons.*
ENGLAND AND WALES.	Potatoes ..	2 958,000	3 151,000	557,800	544,615	5 3	5 8	6·1
	Turnips and Swedes ..	6,611,000	14,193,000	893,423	988,451	7 4	14·4	12·4
	Mangold ..	6,284,000	7,307,000	373,722	384,278	16 8	19·0	18·7
ENGLAND.	Potatoes ..	2,812,000	3,058,000	531,648	516,933	5 3	5·9	6 2
	Turnips and Swedes ..	5,982,000	13,484,000	843,428	932,829	7·1	14 5	12·3
	Mangold ..	6,110,000	7,166,000	363,366	373,699	16 8	19·2	18·7
WALES.	Potatoes .	146,000	98,000	26,152	27,682	5 6	3·5	5·4
	Turnips and Swedes ..	629,000	709,000	49,995	55,622	12 6	12·8	14·5
	Mangold ..	174,000	141,000	10,356	10,579	16 8	13 3	17·1

Potatoes were planted in good time and under favourable conditions, but in many parts of the country the young plants were damaged by late frosts, which occurred even as late as June in some parts, and were especially severe in the Cambridgeshire district, where the crops never recovered from the damage thus inflicted. The prolonged drought also checked growth and the yields on light land were very poor. Sprouting became very prevalent during August. The total production in England and Wales is estimated at 2,958,000 tons, which is some 200,000 tons less than in 1920, but nearly 230,000 tons greater than in 1919. The comparatively large production, which is greater than in any year previous to 1917, is due to the increased area under crop, as the yield per acre—5·3 tons—is about 16 cwt. per acre under average, and 10 cwt. per acre less than the poor crop of last year. Smaller yields per acre have been recorded three times only in the last 35 years. The reduction in yield per acre was most marked in the eastern counties, several counties averaging less than 3 tons per acre. The yields were under average in nearly all parts of England, though over average in most counties in Wales. The yield is estimated at 6 tons per acre in Lincolnshire and over 7 tons per acre in Lancashire.

It has proved very difficult this year to estimate the yields of turnips and swedes, as large but unknown areas of land returned as being intended for sowing with these crops were not sown at all owing to the drought, or were sown very late, with the result that the plants have made very little growth, and the yield of roots is consequently very doubtful. In addition, large areas which were sown failed entirely and were ploughed up. Many crops

which were sown early and promised fairly satisfactory yields were severely attacked by mildew, and the roots are consequently of little use. The estimates of the turnip and swede crop are, therefore, much less reliable than usual. The yield per acre is estimated at 7·4 tons, which is 5 tons under average, and the smallest yield on record. Crops are very light in the eastern, south-eastern, and midland counties, but in the south-west, in the north, and in Wales yields are not so bad, though still well under average. The only counties in which the yields are better than usual are Cumberland and Westmorland, where 18 tons and 17 tons respectively have been obtained. The total production is estimated at 6,600,000 tons, which is 7,600,000 tons less than last year, and 5,700,000 tons below the average of the 10 years.

Mangolds did better than turnips and swedes, but these were checked in growth by the drought, and the roots are generally smaller than usual. Early sown crops were a fairly satisfactory plant, but the later sown germinated unevenly and were generally thin and patchy. The total production is estimated at 6,280,000 tons, or about 1,000,000 tons less than in 1920, but only 10,000 tons less than in 1919. The yield per acre—16·8 tons—is nearly 2 tons below average, but nearly a ton greater than in 1919. Yields were very light in the eastern and south-eastern counties, but most of the northern counties obtained crops which were rather better than usual, while in the midlands yields were only about 1 ton per acre below average.

The very small quantity of roots grown,* combined with the very light hay crops, makes the outlook for the winter feeding of stock far from promising, though the position is more favourable in the north and west (including Wales) than in other parts of the country.

Foot-and-Mouth-Disease.—*Kent:* The existence of Foot-and-Mouth Disease on premises at Under River, near Sevenoaks, was confirmed on 24th November in seventeen heifers. These animals together with 109 breeding ewes, with which they had been pastured, were slaughtered. This outbreak followed an interval of three-and-a-half months during which Great Britain had been free from the disease. There has been no further development either in Kent or any other part of Great Britain.

The usual restrictions were imposed on 24th November over an area of 15 miles radius from the infected premises, but the satisfactory position has permitted a considerable modification of these restrictions. It is anticipated that the remaining general restrictions will be entirely withdrawn by the end of 1921, if the present position is unchanged.

Leaflets issued by the Ministry.—Since the date of the list given on page 857 of the December issue of the *Journal*, the following leaflets have been revised:—

No. 111.—Co-operative Selling of Eggs.
„ 249.—"Couch" or "Twitch."
„ 331.—The Canning of Fruit and Vegetables.
„ 344.—Compound Manures.

Withdrawn leaflets reissued:—

F.P. 41.—The Making of Fruit Pulp, now Leaflet 380.

* See this *Journal* for November, 1921, p. 725.

QUESTIONS IN PARLIAMENT.

Imported Eggs.—Mr. Pretyman asked the Minister of Agriculture whether he will take steps, and if necessary, introduce legislation, to cause foreign imported eggs to be stamped with the name of the country of origin, and so prevent the injury now suffered by both producers and consumers in this country where imported eggs are sold as new-laid British?

Major Barnston (Comptroller of the Household): I have been asked to reply. I understand that the Board of Trade proposes to introduce legislation to give effect to the principal recommendations contained in the report of the Merchandise Marks Committee (Cd. 760 of 1920) with regard to the marking of foreign goods, which include eggs. (November 2, 1921.)

Ecclesiastical Tithe Rent-charge (Rates) Act.—Mr. Pretyman asked the Minister of Agriculture whether the present interpretation of the Ecclesiastical Tithe Rent-charge (Rates) Act, that where an incumbent holds two or more benefices in plurality each benefice must be treated as separate for the purposes of the Act, is in accordance with the intentions of the Government in framing the Act; and, if not, will he introduce a short amending Bill early next session to rectify the error?

Major Barnston: I am advised that the interpretation of Section 1 (2) of the Act, as indicated in the question, although correct, does not represent the intention of the Government when framing the Act, and the question of the practicability of submitting to the House an amendment of the Act is under consideration. (November 2, 1921.)

Summer Time.—Lieut.-Colonel Pownall (by private notice) asked the Secretary of State for the Home Department whether any agreement has yet been come to with the French Government for making the period of summer time commence and terminate on the same date in the two countries?

The Secretary of State for the Home Department (Mr. Shortt): A Conference has recently been held with representatives of the French and Belgian Governments, and an agreement was reached that the summer time period should commence on the night of the last Saturday in March, or the last Saturday but one in March when the last Saturday is the day preceding Easter Day, and end on the night of the first Saturday in October. The Government have carefully considered this proposal, and in view of the serious inconvenience at present caused by the difference between the three countries in the dates of commencing and ending summer time, they have approved the proposal, which corresponds very nearly to the dates which have been fixed in this country, and have informed the French Government that they are prepared to submit to Parliament legislation to give effect to it. It is the intention of the Government to introduce a Bill for this purpose early next Session. I should add that the summer time period in France at present commences on 15th March and ends on 25th October, so that the French Government have made very large concessions in their desire to meet us. December 15, 1921.)

Unfit Horses (Export).—In reply to a question by Mr. A. Herbert regarding the export of horses, Sir Arthur G. Boscawen (Minister of Agriculture) stated that the Ministry's policy is, in substance, so to administer the Exportation of Horses Acts as to ensure that worn-out or decrepit horses,

namely, horses unfit for work, shall under no circumstances be passed for shipment, and that every practicable step shall be taken to secure the comfort of all animals during the passage. For this purpose a very high standard of fitness to travel and to work is insisted upon, and a great improvement has been effected in the fittings of the vessels used for the trade. I understand that maltreatment of horses is already punishable under French and Belgian law, which I have no doubt the authorities do their best to enforce. (November 7, 1921.)

Potatoes from Germany.—In reply to a question by Lord Bledisloe regarding a rumour which, he said, was current in all our chief potato-growing districts, that large quantities of potatoes raised in Germany are being imported, or are about to be imported, into this country through various neutral countries, the Earl of Ancaster stated that the importation of potatoes from the Netherlands and other countries adjacent to Germany in the present year is quite normal, and gives no ground for suspicion that fictitious re-consignment of German potatoes from an intermediate country is being attempted. There is a payment of 26 per cent. under the German Reparation (Recovery) Act, and I understand that the Customs officers have standing instructions to watch importations which might cause suspicion to arise that endeavours are being made to avoid, by fictitious re-consignment from an intermediate country, the payment of this 26 per cent.

Under the Safeguarding of Industries Act, 33⅓ per cent. is charged in certain cases. The first part of that Act does not apply to potatoes; neither does Part II. From enquiries which have been made by the Ministry of Agriculture, I understand that the trade in Continental potatoes is bad. In the few cases where trade is being done the quality is moderate. The Ministry is satisfied that the quantities which are being imported are not an important factor in determining the price of home-grown potatoes. (November 8, 1921.)

Home-Grown Sugar, Limited.—Lieut.-Colonel Willey asked the Minister of Agriculture if the Government have a nominee on the board of Home-grown Sugar, Limited; whether the price now being offered for next year's beet is believed to be substantially below cost of production unless wages are further substantially reduced; and if, in view of the large amount of employment afforded by this industry, he is considering the removal of Excise on home-grown sugar?

Sir Arthur G. Boscawen: The answer to the first part of the question is in the affirmative. At the prevailing rates for wages and transport it is possible that the proposed minimum guaranteed price for next year's beet is below the present cost of production, but in addition to benefiting by any decrease in costs of production, the farmer will share equally with the company in any profits derived from an increase of sugar content above 16 per cent. and of sugar price above £43 per ton duty paid. As regards the last part of the question, home-grown sugar is already receiving favourable treatment, the Standard Excise duty being 19s. 5½d. per cwt., as compared with 25s. 8d. on foreign sugar and 21s. 4½d. on colonial sugar. (November 10, 1921).

NOTICES OF BOOKS.

An Abstract of the Legislation in force in the British Empire, dealing with Plant Pests and Diseases up to the year 1920.—(*E. Marguerite Ralfs, B.A.* London: Imperial Bureau of Entomology, 1921.) As indicated by the title, this is a brief summary of the various orders respecting fungus diseases and insect pests, chiefly in relation to their importation into the various countries with which it deals. It should prove of value not only to the student of economic entomology and plant pathology, but also to the exporter of plants who has hitherto had to rely largely on the information contained in the post office guide, the original orders not being generally available in this country. In some cases particulars are given of the measures in operation for dealing with pests already established. In the case of England and Wales, however, the silver leaf, wart disease, onion smut and American gooseberry mildew orders have been dismissed very briefly. Owing to the frequent changes in phytopathological legislation, the abstract is soon likely to become out of date, and it is hoped that timely revision may be found possible—as a compendium of this kind should fill an undoubted need. If arrangements could be made to include also abstracts of the legislation of foreign countries as well as those within the British Empire, the publication would be even more valuable, and its appearance annually would be fully justified.

Report on a Simple Steam Sterilizer.—(W. A. Hoy and R. Stenhouse Williams. London: Dairy Supply Co., Ltd.) From tests made recently at the National Institute for Research in Dairying, University College, Reading, of a simple steam sterilizer designed for use on dairy farms where no other source of steam is available, it appears that if effective sterilization is to be obtained within a reasonable time, it must be carried out under certain fixed conditions, namely—

(1) The source of heat must be such that steam at 210°F issues from the outlet pipe within a limited time. In these experiments, in which the largest vessel to be steamed was a 17-gallon milk churn, satisfactory results were not obtained until the source of heat, when applied to one gallon of water at 60°F., was sufficiently great to produce steam at 210°F. at the outlet pipe within ten minutes of its first application.

(2) The source of heat must maintain its intensity throughout the steaming.

(3) All milk utensils, including milk churns, should be covered while being steamed.

(4) The steaming should be carried out in a place free from draughts.

(5) An accurate thermometer is essential.

The initial temperature of the room does not appear to affect the operation appreciably. Successful results were obtained when the temperature of the room and of the utensils was as low as 40°F. before steaming commenced.

Conditions conducive to ineffective steaming.—(1) The experiments showed that where an uncovered churn was being steamed and the windows were opened, a fall in the recorded temperatures took place which was further accentuated by the draught caused.

(2) It was shown that efficient steaming, within a reasonable time, was dependent on steam in sufficient volume and at a sufficiently high temperature being produced within a time limit.

The apparatus used in the experiments referred to in the report consisted of an ordinary boiling pan (with steam jet) heated by means of two No. 1 "Primus" Stoves, Roarer Pattern.

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

Agriculture as a Business, *L. Smith Gordon.* (Better Business, Nov., 1920.) [334(04); 338.1.]

The Agriculture Act, 1920, *C. B. Marshall.* (Jour. Farmers' Club, April, 1921.) [347(*e*).]

Intensive Cultivation, *Prof. F. Keeble.* (Rept. Brit. Assoc., 1920, Sect. M.) [63.191.]

How Explosives help to develop Waste Land, *A. W. Wilson.* (Agr. Eng., Vol. 2, No. 6, 1921.) [63.12; 63.196.]

Forecasting the Crops from the Weather, *R. H. Hooker.* (Quart. Jour. Roy. Meteor. Soc., Vol. xlvii., No. 198, April, 1921.)
[A review of the subject of correlation of weather and crops with references.] [551.5.]

The Weather and Cyclical Fluctuations, *W. W. Bryant.* (Econ. Jour., March, 1921.) [551.5.]

Hosten af Roefro i 1920 og Roefrohandelen i Vinteren 1920-1921, *E. Lindhard* and *J. C. Lunden.* (Tidsskrift for Planteavl, 27 Binds, 5 Haefte, 1921.) [63.1951; 63.198.]

Les Micro-organismes du Sol dans leurs rapports avec la Croissance des Plantes : Position actuelle du Problème, *E. J. Russell.* (Ann. Sci. Agron., 38, No. 2, 1921.) [63.115.]

The Nature of Soil Acidity with regard to its Quantitative Determination, *W. H. MacIntire.* (Jour. Amer. Soc. Agron., Vol. 13, No. 4, 1921.) [63.113.]

A Contribution to the Investigation into the Results of Partial Sterilisation of the Soil by Heat, *Viscount Elveden.* (Jour. Agr. Sci., Vol. xi, Pt. 2, 1921.) [63 115.]

Effect of Soil Temperature upon the Development of Nodules on the Roots of Certain Legumes, *F. R. Jones* and *W. B. Tisdale.* (Jour. Agr. Res., Vol. 22, No. 1, 1921.) [63.32; 576.83.]

Relation of Potassium to Growth in Plants, *T. O. Smith* and *O. Butler.* (Ann. Bot., Vol. xxxv, No. 138, April, 1921.) [63.161.]

The Influence of Fertilisers containing Borax on the Yield of Potatoes and Corn—Season 1920, *A. W. Blair* and *B. E. Brown.* (Soil Science, Vol. xi, No. 5, 1921.) [63.161.]

The Effect of Organic Nitrogenous Compounds on the Nitrate-Forming Organism, *E. B. Fred* and *A. Davenport.* (Soil Science, Vol. xi, No. 5, 1921.) [576.83.]

Emploi de CO_2 comme Engrais atmosphérique, *R. Cerighelli.* (Ann. Sci. Agron., 38, No. 2, 1921.) [63.168.]

Increasing the Efficiency of Crude Calcium Cyanamide, *M. Popp.* (Deuts. Landw. Presse, 1920, p. 617 *and* Bied. Zentr., 50 (1921), pp. 216-220.) [63.167.]

Uber die Düngewirkung der Kohlensäure, *A. Gehring.* (Fühl. Landw. Ztg., Jahrg. 70, Heft 7/8, 1921.) [63.168.]

Experiments with "Radio" Manure. The Effect of Coaldust on Crops. [A fertiliser composed of phosphate, burnt lime and coaldust, and claimed to be radio-active.] (N.Z. Jour. Agric., Vol. xxii, No. 3, 1921, p. 162.) [63.169.]

Finely Ground Raw Phosphate—Notes and Opinions on its use in Agriculture, *A. F. Ellis.* (N.Z. Jour. of Agric., Vol. xxii, No. 6, 1921.) [63.1672.]

The Phosphate Industry, *W. Packard.* Part I.—Sources of Supply of Mineral Phosphate. Part II.—Superphosphates. (Jour. Soc. Chem. Ind., Vol. 40 (1921), No. 15, p. 288; No. 16, p. 304.) [63.1672.]

i. The Comparative Effects of Various Forms of Lime on the Nitrogen Content of the Soil, *C. A. Mooers* and *W. H. MacIntire.* ii. The Value of Liming in a Crop Rotation with and without Legumes, *J. G. Lipman.* iii. Liming as related to Farm Practice, *F. D. Gardner.* (Jour. Am. Soc. Agron., Vol. 13, No. 5, May, 1921.) [63.15.]

A Comparison of Magnesian and Nonmagnesian Limestones, *A. W. Blair.* (Jour. Am. Soc. Agron., Vol. 13, No. 5, May, 1921.) [63.168.]

Potash from Kelp, *J. W. Turrentine* and *P. S. Shoaff*. (Jour. Ind. & Eng. Chemi., Vol. 11 (1919), p. 864; Vol. 12 (1920), pp. 682 & 786; Vol. 13 (1921), p. 605.) [63.165; 668.6.]

Die Dungung der Wiesen nach den Ergebnissen von 4-14 jahrigen Versuchen, *Prof. Dr. Paul Wagner*. (Arb. der Deuts. Landw. Gesells., Heft 308, 1921.) [63.16(04).]

The Evolution of Topographical and Geological Maps, *T. Sheppard*. (Rept. Brit. Assoc., 1920, p. 391.) [52; 55 : 912.]

Colloid Problems in Bread-Making, *R. Whymper*. (Rept. Brit. Assoc., 1920, Appendix, p. 61.) [664.6.]

Establishment of Rural Agricultural Communal Libraries in France. (Compt. Rend. Acad. Agr., No. 24, 1921.) [371.]

Sur l'Agriculture polonaise, *M. Jean Dybowski*. (Compt. Rend. Acad. Agr., No. 24, 1921.) [63(4).]

Plant Breeding, *T. Anderson*. (Trans. H. & A. Soc. of Scot., Vol. xxxiii, 1921.) [575.4.]

The Influence of Atmospheric Variations on the Weight of Bagged Wheat (with graphs), *F. B. Guthrie*, *G. W. Norris* and *J. G. Ward*. (N.S.W. Agric. Gaz., Vol. 32, Part 3, Mch., 1921.) [63.311(04).]

Field Crops.

Root Development in Barley and Wheat under Different Conditions of Growth, *W. E. Brenchley* and *V. G. Jackson*. (Ann. Bot., Vol. 35, No. 140, Oct , 1921.) [63.311(04); 63.313.]

The Development of the Flower and Grain of Barley, *W. E. Brenchley*. (Jour. Inst. Brewing, Vol. 26, pp. 615-632.) [63.313.]

A Comparative Study of the Composition of the Sunflower and Corn Plants at Different Stages of Growth, *R. H. Shaw* and *P. A. Wright*. (Jour. Agric. Res., Vol. xx, No. 10, 1921.) [63.33(d); 612.394.]

Nettles as a Forage Crop, *W. E. Brenchley*. (Modern Farming, May, 1921.) [63.33 (d).]

Spartina Problems, *Prof F. W. Oliver* (Ann. App. Biol., Vol. vii, No. 1, 1920.) [58.2; 63.33(d)]

Biologie Végétale—Sur le pollen du Lin et la dégénérescence des variétés cultivées pour la fibre, *M. L. Blaringhem*. (Compt. Rend. Acad. Sciences, Tome 172, No. 25, 1921, p. 1603.) [63.34111.]

Tobacco Growing in Ireland: The Experiments in 1920 (with a list of previous articles), *G. N. Keller*. (Jour. Dept Agr. &c., Ireland, Vol xxi, No 2, 1921, p. 200.) [63 3461(04).]

Essais de sorgho et maïs à sucre en vue de la production de l'alcool industriel effectués dans les Pyrénées-Orientales en 1917, *J. Ruby*. (Ann. Sc. Agron., 37th year, No. 2, May-July, 1920) [63 349.]

The Institute of Brewing Research Scheme.—Report I.—Breeding of New Varieties of Hops at Wye, Manurial Experiments, &c. (Jour. Inst. Brewing, July, 1921.) [63.3451.]

The Industrial Utilisation of the Potato, *A. E. Harris*. (Jour. Roy. Agr. Soc. Eng., Vol. 81, 1920.) [63 344; 63.512(04).]

Die Bewertung von Kartoffelsorten nach ihrer Widerstandstraft gegen Krankheiten, *H. W. Wollenweber*. (Deuts. Landw. Presse, Jahr. 47, Nr.83, 1921, p. 569.) [63 512(04).]

Fruit Growing.

The "Running Off" of Black Currants, *R. G. Hatton*. (Jour. Pomology, Vol. ii, No. 3, 1921.) [63.41(c).]

Root Development in Newly Planted Trees, *B. T. P. Barker*. (Agr. and Hort. Res. Sta., Long Ashton. Ann. Rept., 1920.) [63.41(04).]

Plant Diseases.

The Sources of Infection of Potato Tubers with the Blight Fungus, *Phytophthora infestans*, *Paul A. Murphy*. (Sc. Proc., Roy. Dublin Soc., Vol. 16 (N.S.), No. 29, Aug.. 1921.) [63.24.]

Award of the Boyle Medal to Geo. H. Pethybridge, B.Sc., Ph.D. (with a brief report of his investigations of potato blight—*Phytophthora infestans*—and other work, and a list of papers published by him.) (Sci. Proc. Roy. Dub. Soc., Vol. xvi (N.S.), No. 20, 1921.) [63.24.]

Lightning Injury to Potato and Cabbage, *C. R. Orton*. (Phytopathology, Vol. xi, No. 2, Feb., 1921.) [63.21.]

Leafroll, Net-Necrosis, and Spindling-Sprout of the Irish Potato, *E. S. Schultz* and *D. Folsom* (Jour. Agric. Res., Vol. xxi, No. 1, 1921.) [63.24-33.]

Pests and Diseases of Barley and Malt. Part I—Injurious Insects, *F. A. Mason.* (Jour. Inst. Brewing, July, 1921.) [63.27-31; 63.27-34.]

Genetics of Rust Resistance in Crosses of Varieties of *Triticum vulgare* with Varieties of *T. durum* and *T. Dicoccum*, *H. K. Hayes*, *J. H. Parker* and *C. Kurtzweil.* (Jour. Agric. Res., Vol. xix, No. 11, 1920.) [575.1.]

Biological Studies of *Aphis Rumicus* L., *J. Davidson.* (Sc. Proc., Roy. Dublin Soc., Vol. 16 (N.S.), No. 25, Aug. 1921.) [63.27.]

The Woolly Aphid of the Apple and Elm (*Eriosoma lanigera*, Hausmann), Part II.—Treatment, *F. V. Theobald.* (Jour. Pomology, Vol. ii, No. 3, 1921.) [63.27.]

A Transmissible Mosaic Disease of Lettuce, *I. C. Jagger.* (Jour. Agric. Res., Vol. xx, No. 10, 1921.) [63.24-51.]

On the Occurrence in Britain of the Ascigerous Stage of a " Brown Rot " Fungus (*Schlerotinia*), *H. Wormald.* (Ann. Bot., Jan. 1921.) [63.24.]

Dry Rot, *J. C. Jull.* (Jour. Surveyors' Inst., Vol. i, Pt. 5, Nov., 1921.) [63.24.]

A Dry Rot Canker of Sugar Beets, *B. L. Richards.* (Jour. Agr. Res., Vol. 22, No 1, 1921.) [63.24-34]

Prufung von Pflanzenschukmitteln im Jahre 1920, *Dr. E. Riehm.* (Mitt. Biol. Reich. fur Land-u Forst., Heft 20, 1921.) [63 295.]

The Present Status of Lime-Sulphur Solution vs. Dry Materials, *G. P. Gray.* (Calif. Dept. of Agr. Monthly Bull., Vol. x, No. 5-6, 1921, pp. 177-182.) [63 295.]

" Browning " and " Stem-Break " Disease of Cultivated Flax (*Linum Usitatissimum*), caused by *Polyspora Lini*, *H. A. Lafferty.* (Sc. Proc., Roy. Dublin Soc., Vol. 16 (N S), No 22 Aug., 1921.) [63 24.]

Investigations in Flax Diseases, *G. H Pethybridge*, *H. A. Lafferty* and *J. G. Rhynehart.* (Jour. Dept. Agr , &c., Ireland, Vol. 20, No. 3, 1920, *and* Vol. xxi, No. 2, 1921) [63.24-34; 63 27-34]

Live Stock.

The Application of the Food-Unit Method to the Fattening of Cattle, *James Wilson.* (Sci. Proc Roy. Dub. Soc., Vol. xvi (N.S.), No. 3, 1920) [63.625.]

Sunflower Silage Digestion Experiment with Cattle and Sheep, *R E Neidig*, *R. S. Snyder* and *C. W. Hickman.* (Jour. Agric. Res., Vol xx, No. 11, 1921.) [612.394; 63.604(a).]

A Mendelian Experiment with Aberdeen Angus and West Highland Cattle, *J. A. S. Watson.* (Jour. Genet., Vol. xi, No. 1, April, 1921.) [575.1.]

Effect of Ration on the Development of Pigs, *C. O. Swanson.* (Jour Agric. Res , Vol. xxi, No. 5, 1921.) [63.645.]

The Composition of the Rhizomes of Bracken and its Variations, *J. Hendrick.* (Roy. Bot. Gard., Kew, Bull. Misc. Inform., No. 4, 1921.) [63.604(a).]

Untersuchungen über den Futterwert des nach verschiedenen Verfahren aufgeschlossen Strohes :—II.—Aufschlusz des Strohes durch Atzkalk mit und ohne Druck; III.—Aufschlusz des Strohes mit Soda. *F. Honcamp* and *F. Baumann.* (Landw. Vers.-Stat., Bd. 98, Hft. 1/2) [63 604(a).]

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Notes on Breeding for Increase of Milk in Dairy Cattle (with 8 Pedigree Charts), *E. Robertson.* (Jour. Genet., Vol. xi, No. 1, 1921.) [575.4.]

Red Poll Cattle. The Milk Side of a Dual Breed. (Jour. Brit. Dairy Farmers' Assoc., Vol 33, 1921.) [63.711(04).]

The Use of Cotton-seed Meal to Increase the Percentage of Fat in Milk (with references to publications on Feeding Trials with Cows), *A. C. McCandlish* (Jour. Dairy Science, Vol. 4, No 4, 1921. pp. 310-333.) [63.711(a).]

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Die chemisch-physikalische Beschaffenheit der Milch ihr Nachweis und ihr Einfluss auf die Kasefabrikation mit besonderer Berücksichtigung der Labgerinnung zu Grunde liegenden Verhältnisse, *Dr. G. Koestler.* (Landw. Jahrb. der Schweiz, Heft 3, 1921.) [63.712.]

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 11.

FEBRUARY, 1922.

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

NOTES FOR THE MONTH.

Practical Application of the Results of Agricultural Research.

SEVERAL enquiries have been addressed to the Ministry by farmers and market gardeners who wished to make a practical trial of the method of converting straw into farmyard manure on the lines of the experimental work carried out at Rothamsted* by Dr. Hutchinson and Mr. Richards. Though the principle involved is established and presents no difficulties, the practical application involves much consideration of detail both with regard to attention to particular points on which success on a large scale depends and also to the conditions on a particular farm which will secure due economy of labour and material. The Ministry, therefore, advises such enquirers as may be desirous of proceeding further into the matter to put themselves into communication with the Agricultural Development Company which Lord Elveden has established on the public-spirited lines described in the letter printed below:—

15th December, 1921.

Sir,—For some years past I have been deeply interested in the furtherance of Agricultural Research and have been frequently impressed with the lack of adequate organisations to undertake the development of Research results to the stage of application to practical farming.

In the case of seeds, the National Institute of Agricultural Botany fills the need, but there is no similar organisation concerned with fertiliser and soil problems.

I have now decided to form a company called the Agricultural Development Company to fill the gap, in which company I shall provide the capital required in the first instance.

The primary object of the Company will not be to make profits for the benefits of its shareholders, but to try and develop as a

* This *Journal*, August, 1921, p. 398, and September, 1921, p. 482.

business such processes as, for example, that for converting straw into artificial manure, discovered and applied by Dr. H. B. Hutchinson and Mr. E. Hannaford Richards, of Rothamsted.

It has always been my ambition to see whether it is not possible to make certain branches of Scientific Research self-supporting; and since any progress to this end requires the employment of a qualified staff and the purchase of mechanical plant, persons desirous of participating in the advantages to be derived from the process may quite fairly be expected to contribute to the cost of development by a reasonable payment either in the nature of a royalty or otherwise.

I am hoping to obtain the co-operation and assistance of those farmers who will benefit by the scientific work, as a result of which this discovery has been made possible.

The royalties now to be fixed will be available, after payment of expenses, to form a fund for further Scientific Research along practical lines in Agriculture, and in view of this I feel sure that no difficulty or objection will arise on the part of the farmers who avail themselves of this discovery to make a reasonably small payment for the right to use it, and to technical advice and assistance in its practical operation.

In view of the number of people who have followed with interest what has so far been done, I think the above information will be useful. Any communications with regard to the facilities afforded by the Company should be addressed to The Agricultural Development Company, 12, Spencer Road, Harpenden, Herts.

Yours faithfully,

The Secretary, (Sgd.) ELVEDEN.

Ministry of Agriculture and Fisheries.

AT the beginning of January the Ministry of Agriculture issued the following announcement to the Press:—

Payment of Claims under the Corn Production Acts.

"The Ministry of Agriculture is now issuing to farmers throughout England and Wales cheques in payment of claims under the Corn Production Acts for wheat and oats produced in 1921, the sums paid being at the rate of £3 for each acre of wheat and £4 for each acre of oats.

"About 155,000 cheques have already been dispatched and a further 4,000 cheques will be sent out in the course of next week. The payments which are now being made are in respect

of claims made before the 18th of July last which was fixed as the final date for receiving applications. Subsequently claims were accepted up to 3rd October as an act of grace and on the understanding that payment could not be made at the beginning of the year. These latter claims number about 30,000 and these will be paid in the course of a month or six weeks, together with any outstanding cases remaining from the earlier claims, where for one reason or another the accuracy of the claim has not been proved to the satisfaction of the Ministry. In the case of about 25 per cent. of the claims received further enquiry has been necessary, and although most of these have been satisfactorily settled, a proportion still remains to be dealt with. Many of these consist of cases where an incoming and an outgoing tenant have claimed for the same crops. It is anticipated that when all claims have been paid the total sum which will have been received by growers of wheat or oats in England and Wales will amount to about £15,000,000.

"The examination and payment of these claims involves an immense amount of work which is being carried out by a temporary staff of ex-Service men under the supervision of permanent officers of the Department, and although a large part has been disposed of, much remains to be done. Persons whose claims have been duly acknowledged can rely on receiving payment in due course and are requested not to write to the Ministry making enquiries on the subject as such letters necessarily tend to delay the rapid progress of the work."

By the time this *Journal* appears a further 17,000 claims will have been paid, and by the middle of the month very few cases indeed will remain outstanding.

Exportation of Horses: New Order.

AN important new Order has been issued by the Ministry entitled the "*Exportation and Transit of Horses, Asses and Mules Order of 1921*," the object of which is the better regulation of the traffic in horses by sea and rail, with a view to the protection of the animals against avoidable suffering. The Order is complementary to the Diseases of Animals Act. 1910, and the Exportation of Horses Act, 1914, which prohibit the shipment of any horses from this country to the continent of Europe unless they have been passed by a veterinary inspector of the Ministry as fit to travel and fit to work. The arrangements for the administra-

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tion of these Acts were reorganised in the spring of last year, when whole-time veterinary inspectors of the Ministry were appointed to carry out the inspections at all the regular ports of shipment, and such a standard of fitness was established that the shipment of any worn-out or decrepit horse has been entirely stopped.

The new Order pursues this matter further by prescribing a certain definite standard to which the fittings of all vessels engaged in the transport of horses by sea from this country are required to conform by 1st April, 1922, and states clearly the provision which is to be made for feeding and watering the animals before embarkation and during the passage. Among other provisions the Order definitely prohibits the carriage of horses, asses or mules during the winter months except under a permanent deck cover.

Much has, however, already been done during the past 12 months to improve the fittings of vessels engaged in this trade. Although the provisions of the Order may necessitate some further expenditure on the part of shipping companies in alterations of fittings of vessels used for carrying horses by sea, they are regarded as essential for the proper protection of the animals against avoidable suffering. The marine department of the Board of Trade was closely consulted by the Ministry when framing the Order and that Department considers the Order to be a practicable one.

Horses exported to any port on the continent of Europe can now be shipped only at the ports of London, Leith, Goole, Hull, Harwich, Folkestone or Southampton. A notice in writing of every intended shipment has to be given to the Ministry's veterinary inspector at the port so as to reach him by 2 p.m. on the preceding day. Horses must be at the place of shipment at least one hour before the examination commences. During this period they are kept under close supervision to prevent doping or the adoption of any other device by unscrupulous dealers to make them appear fit when examined.

In addition, the Order re-enacts, with certain improvements, the existing provisions relating to the carriage of horses by rail, from the point of view of the prevention of avoidable suffering. Horses carried in trucks open at the sides have to be protected by tarpaulin sheets. When the journey is protracted the horses must be fed at least once in every 24 hours. The provisions as to the cleansing and disinfection of vessels and railway vehicles

used for the carriage of horses have been entirely revised. An important change in this respect is the abolition of the use of limewash, and the substitution of an efficient disinfectant.

Copies of the Order can be obtained from the offices of the Ministry, 4, Whitehall Place, London, S.W.1.

Ministry's Exhibits at Agricultural Shows.

MANY farmers were interested in the Ministry's exhibits at certain of the agricultural and horticultural shows which were held in various parts of the country during the past year. In all, 24 shows were visited in 1921, including a number of the important ones, such as those of the Royal Agricultural Society at Derby, and the Bath and West Society at Bristol, as well as certain county and fat stock shows. The Ministry's exhibits have been mainly concerned with advances in agricultural research and education; with agricultural machinery; the improvement of dairying; milk recording; horticulture; fruit bottling and preservation; seed-testing and the destruction of weeds; the improvement of small livestock and bee-keeping; improvement of grassland; and, as a special section, the work connected with the repression of insects and fungi inimical to food production. In connection with the last-named, excellent models of the pests have been specially prepared under the supervision of the Ministry's Entomologist and Mycologist at the Phytopathological Laboratory, Harpenden. Specimens of ordnance survey maps have also been exhibited.

The Ministry's exhibits attracted a large number of visitors; inquiries by farmers and others were numerous; many leaflets and publications were distributed free; and priced publications to the value of about £215 were sold.

In addition to sending the main exhibit to shows, the Ministry lent smaller exhibits to a few local shows on payment of the cost of rail charges by the societies concerned. In general, it is believed that the year's work, both from the point of view of numbers visiting the exhibits and information sought and given, has proved really satisfactory and of value to those the Ministry sought to help. The expenditure which is allowed for this work is very small, but the question of renewing, improving, and adding to the exhibits in order that they may be useful to the fullest degree is being kept carefully under review.

Conciliation Committees—Long Period Agreements.

An interesting agreement for farm wages was reached in Northampton on 18th January when the employers and workers on the Conciliation Committee made terms for a period extending up to the 6th October. Although there were 23 farm wage agreements in operation at that date, there were only two long-period agreements made covering the whole season up to the end of harvest. Such agreements have the advantage on the one hand of giving farmers a settled rate of wage over a period when farm operations—including both hay and corn harvest—are in full swing, while to the labourer they offer a fixed minimum wage which will enable him to benefit by any further fall in the cost of living which may occur during the agreed period.

The principal clauses in the Northampton agreement provide that:—(1) The wages of male agricultural labourers of 21 years of age and over shall be 32s. for a week of 48 hours from 18th January, 1922, until 3rd March, 1922, and 31s. for a week of 50 hours from 4th March, 1922, until 6th October, 1922; (2) the overtime rate from 18th January, 1922, until 3rd March, 1922, shall be 8½d. per hour, and from 4th March until 6th October, 8d. per hour; (3) the ordinary time and overtime rates only shall apply during hay and harvest periods; and (4) there shall be a guaranteed week of 48 hours from 18th January, 1922, until 3rd March, 1922, and of 50 hours from 4th March, 1922, until 6th October, 1922. Provision is also made for the wages of workers under 21 years of age.

A somewhat similar agreement has been reached in Pembroke covering the period up to the 4th October at a rate of 34s. per week for 50 hours.

The example of these two counties will no doubt be carefully considered by other Conciliation Committees, and may lead to agreements being reached for longer periods with benefit both to the farmer and the worker.

The agreements relating to adult male workers, which were in force on the 20th January, were as follows:—

Area.	*Period.*	*Wages.*	*Hours per week.*
Cheshire	Up to 30th April, 1922	36/-	54
Cumberland and Westmorland ...	„ 2nd Feb., „	37/6	54 in summer 48 in winter
Durham	„ 1st March, „	44/6	50
Hampshire ...	„ 1st March, „	8d. per hour; guaranteed week of 48 hours.	—

Area.	*Period.*	*Wages.*	*Hours per week.*
Hertfordshire ...	Up to 3rd Feb., 1922	8d. per hour; guaranteed week of 48 hours.	—
Isle of Ely ...	" 28th Feb., "	31/- Horsemen or milkmen 40/6 for customary hours.	48
Leicester—Ashby, Bosworth, Hinckley and Atherstone.	" 31st March, "	35/- Weekday overtime 10d. per hour. Sunday employment 1/- per hour.	50
Leicester—Melton Mowbray and District.	" 1st March, "	34/- per week during Jan.	50
		32/- per week during Feb.	50
Middlesex, S.W. ...	" 28th Jan., "	9½d. per hour up to 50 hours with a guaranteed week of 48 hours. Carters, stockmen, &c., 47/6.	60
Northants ...	" 3rd March, "	32/-	48
	" 6th Oct., "	31/-	50
South Northumberland	" 13th May, "	44/6	50 in summer 48 in winter
Nottinghamshire ...	" 28th Feb., "	34/-	50
Rutland	" 31st Jan., "	34/-	48
Staffordshire ...	" 29th Jan. " (able-bodied workers)	9½d. per hour for a minimum week of 50 hours.	—
Surrey	" 28th Feb., "	33/4	50
Worcestershire ...	" 1st March, "	36/-	48
Yorkshire, North Riding ...	" 1st March, "	37/-	50
Brecon and Radnor	" 28th Feb., "	34/-	50
Cardiganshire ...	" 28th Feb., "	36/-	54 in summer 50 in winter
Carnarvonshire ...	" 13th May, "	35/-	50 in summer 48 in winter
Merioneth and Montgomery ...	" 31st Jan., "	35/-	50
		38/-	56
Pembrokeshire ...	" 4th Oct., "	34/-	54
Glamorgan ...	" 31st Jan., "	36/-	50

Of the above, the agreements in Surrey and the Isle of Ely have been confirmed by the Minister on the application of the Committee.

Further details of the agreements in each county can be obtained on application to the Ministry.

The Agricultural Index Number.

PRICES of agricultural produce in England and Wales, according to the index figures prepared each month by the Ministry, were slightly lower in December than in the previous month, the average of prices being about 82 per cent. above the pre-war level, as compared with 84 per cent. in November. Except for the month of August, when a rise of 16 points was recorded, due principally to a substantial advance in the price of milk, the decline was continuous throughout the year. The following table shows the percentage increase in prices of agricultural produce, in each month during the past three years, as compared with the average of the three years 1911-13 :—

Month.	1919.	1920.	1921.
	Per cent.	*Per cent.*	*Per cent.*
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	105
October	166	191	90
November	182	197	84
December	207	194	82
Year	158	192	121

No very great changes were recorded from November to December. Wheat and oats recovered in value to some extent, after falling continuously from June onwards, but barley was again cheaper. Live stock of all descriptions were easier in value, with the exception of fat and store sheep, which showed no appreciable alteration from the November level. Eggs reached their highest point at the end of November, and the December average of prices was substantially lower than in the previous month. Dairy produce increased in value, the average price paid to producers for milk delivered under contract to large towns showing an advance of about 1¼d. per gallon on the month; in comparison with pre-war prices, milk easily maintains its position as the dearest form of agricultural produce, and it is not surprising that of all descriptions of live stock, dairy cows show the heaviest advance in value compared with 1911-13. Of the other descriptions of produce sold by farmers, the most important are hay and potatoes, both of which showed slight declines on the month.

Feeding stuffs in most cases advanced in value from November to December, the chief increase being recorded for bran, which in December was at about double its pre-war price. Fertilisers showed little alteration, with the exception of basic slag, which was considerably cheaper; superphosphate showed a slight decline, and sulphate of ammonia an equally slight rise.

Wart Disease of Potatoes: Approved Immune Varieties.

IN December, 1919, the Ministry issued a descriptive list of those varieties of potatoes which after careful trial had been approved as being immune from Wart Disease and which might be planted on land infected with the disease. As a result of the trials carried out in the following year, a supplementary list of seven varieties also approved as immune was issued in December, 1920. Copies of both these publications are obtainable free and post free on application to the Ministry. The list has now been further extended by the addition of the under-mentioned varieties which, following the trials conducted at Ormskirk in 1921, have been approved as immune.

First Early Variety—

Dunvegan (Sutton).

Tubers.—Oval; eyes very shallow; skin white with yellow cast; flesh lemon.

Colour of Sprout.—Purple.

Haulm and Foliage.—Dwarf, bushy foliage; leaves medium, medium green.

Flowers.—White, rarely formed.

Late or Maincrop Varieties—

Barley Bounty (Salaman).

Tubers.—Kidney; eyes shallow; skin white; flesh white.

Colour of Sprout.—Slight reddish purple.

Haulm and Foliage.—Straggling; leaves small; light green.

Flowers.—Heliotrope, rarely flowers.

Ranfurly Red (Sutton).

Tubers.—Round; eyes medium; skin red; flesh white.

Colour of Sprout.—Deep rose.

Haulm and Foliage.—Upright to spreading; leaves medium to large, drooping corrugated, medium green.

Flowers.—White, profuse

The Celt (Findlay).

Tubers.—Round; eyes medium; skin white; flesh white.

Colour of Sprout.—White breaking red.

Haulm and Foliage.—Upright, vigorous; leaves small, medium green, corrugated.

Flowers.—Mauve, tipped white, profuse.

The immunity from wart disease of certain varieties of potatoes was first discovered in 1908, and trials were then instituted for the purpose of testing varieties of potatoes to obtain definite information as to their immunity or otherwise. These trials have been continued since that date, and year by year the Ministry has been able to declare fresh varieties as being immune. Including the four varieties mentioned above, no fewer than 100 names have appeared on the list of approved immune varieties. It is now known that some of these names relate to the same variety, and after omitting the synonyms the number of distinct varieties now recognised as immune is 63.

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Aber and District Welsh Mountain Pony Improvement Society.

A SUCCESSFUL experiment for improving the breed of Welsh Mountain Ponies was undertaken last season in the mountainous district of Aber, near Bangor. Normally premiums are awarded by the Ministry only in those cases where the Commons Act of 1908 is in force, as this Act provides for the formation, by the persons entitled to use the "common," of a society whose object is to regulate the turning out of entire animals on the common. As it was considered impracticable to adopt the Commons Act in this instance, the commoners formed a society for the hire of a suitable stallion and the members of the society turned the best of their mares into an enclosed "ffridd" or grazing ground some 60 acres in extent, in which the stallion "Grove Charcoal" was allowed to run with the mares for a period of three months. The hiring of the stallion cost £15, towards which a grant of £10 was made by the Ministry, and fees for service (10s.) and grazing (12s.) were charged for each mare. Sixteen members sent 35 mares for service and it is anticipated that about 60 mares will be served in 1922.

The Ministry's Publications in 1921.

THE *Journal*.—Of the Ministry's publications probably the best known and certainly the most important is this *Journal*. Started in 1894, its growth has been gradual and steady, and, as an indication of the increased confidence which is being placed in it, it may be recorded that the last 15 months have shown an increase of 2,000 in the number of subscribers. Adverse agricultural conditions may have had something to do with this, for it is generally realised that difficult

conditions can only be countered by better methods. If this assumption is correct, the increased *Journal* sales are a tribute to the practical common sense of the farmer, for the *Journal*, as an official publication, endeavours to supply useful information of direct and practical value. The sales for December last exceeded 10,000, or about double those of pre-war days.

Miscellaneous Publications.—A range of subjects almost as wide as that of the *Journal* has been covered by the Ministry's Miscellaneous Publications during the last year. A valuable addition to the records of Plant Pests in this country was made by the "Report on the Occurrence of Insect and Fungus Pests on Plants in England and Wales for the year 1919," which, though of most interest, perhaps, to the scientist and student, has yet had a considerable sale. This series of reports is being continued, and the report for the years 1920 and 1921 will be issued shortly.

The value to trade of the practical application of mycology is, perhaps, more clearly shown in the case of the "Trials of Varieties of Potatoes Immune to Wart Disease, 1920," from which trials some commercially sound varieties of potatoes have emerged with added lustre. Much useful information on the growing of clover and grasses in this country is to be found in "A Survey of the Principal Seed-Growing Counties." The rapid progress made by the Milk Recording Scheme of the Ministry is evidenced by the steady demand for Volume 4 of the Register of Dairy Cows.

The three most popular volumes issued by the Ministry during the year have undoubtedly been:—"Rations for Livestock." by Professor T. B. Wood; "Manuring of Pastures for Meat and Milk," by Professor W. Somerville; and the "Handbook of British Breeds of Livestock."

Of these three volumes some 1,200 copies were sold in November alone, and all three have required three editions during the last 18 months.

Volumes in preparation include "Hedge and Stump Clearing Devices,. Report on a Test conducted at Long Ashton, Hampshire," which will give the public authoritative results obtained at the trials of every method of extracting tree stumps in common use in this country.

Of particular value to farmers, schools and colleges—indeed, to private gardeners also—will be a new publication on "Beneficial Insects," which will include two pages of coloured illustrations, beautifully prepared, scientifically accurate and finely reproduced (in the press).

Bound Volumes of Leaflets.—The most popular volumes ever published by the Ministry have been the three Bound Volumes containing leaflets Nos. 1-300, the first volume of which has run through editions totalling 100,000 copies, while the total number of copies printed of the three volumes together has reached 225,500. For some time it had been found very difficult to keep up to date volumes containing 100 assorted leaflets, dealing with many different aspects and subjects of agriculture. From all quarters new information, sometimes of the highest importance, is constantly being brought to light, necessitating frequent revision of leaflets. Accordingly the bound volumes are being superseded by a series of small Sectional Volumes on distinct subjects, any one of which can be revised at short notice. This new system has the additional merit that it presents the leaflets in a handier form, particularly to the specialist. Five volumes of the series have already been published and others are in preparation: pending their issue the Bound Volumes are still on sale. The five volumes already issued are :—

No. 1.—Fungus Pests of Fruit Trees.	8d.	(post free).
,, 2.—Insect Pests of Fruit Trees.	10d.	,, ,,
,, 3.—Cultivation and Diseases of Potatoes.	8d.	,, ,,
,, 4.—Fruit: Its Cultivation, Marketing and Preservation.	1s. 6d.	,, ,,
,, 5.—Diseases of Animals.	1s.	,, ,,

Leaflets.—The end of the year saw one change which, at first, may meet with the approval of few and the disapproval of many, namely, the decision to make a charge for leaflets contributory to the cost of their production. Apart, however, from the fact that the Ministry was compelled to take this step by the need for economy, many who dislike the change will agree that, as the information in the leaflets has a commercial value, those who require them should contribute to the cost of their production. Moreover, if the appreciation of information of any kind does not necessarily increase in proportion to the price paid for it, there is little or no doubt that too easy acquisition breeds not appreciation but waste, and to that extent the fact of payment does add to the value of a leaflet, and is at the same time an economy. The demand for leaflets has been very heavy, and it should be remembered that if the Ministry is able to send a copy of any one of its leaflets free to any applicant, it does not follow that this can apply to the whole 385 issued, or even to a dozen of them.

THE SHRAWARDINE TRACTOR TRIALS, 1921.

THOMPSON CLOSE, B. J. OWEN, B.Sc., B.Eng., etc., and
H. G. RICHARDSON, M.A., B.Sc.
Ministry of Agriculture and Fisheries.

THE Tractor Trials conducted at Shrawardine from the 19th to the 24th September last were arranged by the Society of Motor Manufacturers and Traders and were conducted on the same basis as those held by the same society in 1919.* There was therefore no attempt made, as at the trials organised last year jointly with the Royal Agricultural Society, to place the tractors in any order of merit,† but the object was to state the actual results achieved by each machine entered. The report was issued very soon after the conclusion of the trials, having regard to the amount of work involved in the compilation of the tables, and in this as in other respects the trials reflect great credit on the organisers.

The area chosen for the trial ground was admirably suited to the purpose, and although it was somewhat difficult of access, this is a drawback almost inseparable from trials or demonstrations of any size. The total area of about 500 acres was divided between 25 fields all within comparatively easy reach of Shrawardine station and the headquarter's offices. The soil varied from medium to heavy four-horse land, and only in one or two fields was it really light. The programme was so arranged as to permit all the tractors entered to be at work every day and all day, and there was very little idle time anywhere. A special effort had been made to record the performances of each machine as accurately as possible: and while improvements might be conceivable in points of detail it can fairly be said that the trials were conducted under as favourable conditions and with as efficient an organisation as it is reasonable to expect.

For recording some of the main factors in the work actually performed by the machines, Watson dynamometers were employed, designed by the Consulting Engineer of the Society. The instruments were calibrated at the National Physical Laboratory. The dynamometers are designed to record graphically the draw-bar pull, the distance travelled, the time occupied and

* See this *Journal*, October, 1919.
† *Ibid*, November, 1920.

the depth of furrow. Examples of the graphs obtained are reproduced in the report: they show clearly the time taken in turning at the headlands and the decreased pull as well as many other details of great interest. Another instrument used was the Heenan and Froude dynamometer which was employed for calculating the belt horse-power.

It had been intended to include in the trials, tests of tractor implements: but neither the time available to the technical staff employed nor the equipment on hand was really adequate for any such purpose and in the result nothing of moment was attempted. However, the opportunity given to manufacturers to exhibit tractor implements both of standard type and new design was a welcome one, which was calculated to assist farmers in the selection of implements.

Tractors and Implements Participating in the Trials.—Forty tractors were entered for the trials and 38 actually took part: of this number 11 were duplicates, and 27 different types were therefore tested. Four machines were new to British Tractor Trials:—The Renault, Avance, Simar and Service Garden Tractor. Many of the machines seen in previous trials did not enter. As contrasted with the 1920 trials the most notable absentees were the cable sets: no tractor operated by steam power was present.

Tractors have not undergone any material alteration in design since the 1920 trials, nor was there amongst the entries any considerable departure from the principles which are more or less generally accepted. There must, of course, be a number of types since there exists such a variety of conditions of soil, and one of the most interesting entries was the set of 10-18 H.P., 15-27 H.P. and 22-40 H.P. models constructed by the Case Tractor Co. The only real departures from the commonly accepted design were to be found in the Glasgow and the Avance tractors. The Glasgow tractor, with its three ground wheels all power-driven and of equal size, is well known for its hill climbing capacity and its remarkable adhesion, while the nature of the drive causes no unbalanced torque and the machine is therefore deprived of any tendency to rear or reduce its wheel pressure when pulling hard. The Avance tractor is a Swedish production and is new to British practice, the engine being of the single-cylinder two-stroke semi-Diesel (hot-bulb) type, mounted high up in the fore part of the frame and driving through friction clutch and gears to a pinion and toothed ring final drive. This machine has many interesting features; it can be used either as a four-wheel self-contained unit with two furrow plough or as a

tractor hauling a separate implement. Crude oil was used as fuel and the engine appeared to be operating satisfactorily. Gardon tractors were represented by the Service and Simar machines. The Service is a miniature tractor controlled by an operator walking behind, and the Simar is operated in the same way. The latter is made in two sizes but the smaller one only was entered. The special feature of this machine is the rotary spring-mounted tines of round section steel which till the land and produce a fine tilth in one operation as though plough and harrow had been used.

The implements submitted for test included eleven ploughs, nine cultivators, two harrows, one disc harrow and three excavators. Among the ploughs were to be found a skim plough, a stubble breaker and specially designed sub-soiling ploughs.

Performance and Tests.—A pleasing and noteworthy fact was that of the 38 machines tested and demonstrated there was not one single failure. It was clearly demonstrated that machines of different types can work steadily for a week without one of them being held up for any mechanical defect other than some unimportant detail easily remedied.

The tractor drivers did not attempt to give exhibition performances, but ran their machines as if under normal conditions, and this was reflected in both the regularity of running and absence of stops due to mechanical defects. In previous trials breakdowns have been frequent, and it is apparent therefore that manufacturers have recognised and remedied defects which showed themselves in past years, while the experience gained has not been lost upon the organisers of the trial as the machines were set to do work well within the limit of their powers.

With regard to the performance of individual machines, any attempt to deal with each one, judging from mere observation of the work done, would be mere repetition, the uniformity of excellence being notable.

The power tests that were carried out were of very great interest. The engines were all submitted to a belt power test by means of a Froude dynamometer, and in addition underwent a draw-bar test by which the overall mechanical efficiency was observed. A point made clear during these tests was that in the majority of cases only a fraction of the total power developed was available for useful work, due to the lack of adhesion or gripping power in the driving wheels. Frequently the draw-bar horsepower did not represent more than one-third of the power which

the engine of the tractor was capable of producing. In nearly every case submitted to the draw-bar test, the draw-bar pull was limited by adhesion. This may have been due in part to the hard state of the ground, but even making allowance for this, the results must be considered disappointing. It is clear that the problem of adhesion needs careful and prolonged study and that this is a field of research which—like many others—should be taken up as part of a programme for investigations in agricultural machinery which may be framed either by the Ministry as part of its research scheme or by manufacturers, or by both working in conjunction. Trials cannot do more in this direction than focus attention upon a common feature or defect of machines of a wide range of types.

It has already been said that except in some points of detail the organisation of the trials was excellent, and it will not be regarded as adverse criticism if reference is made to a point which has been noticed elsewhere. In some instances advantage was not taken of the dynamometer self-registering depth gauge, and the determination of the average depth, load and speed was in effect a matter for the unaided judgment of the observer. This, however, was a failure of the human instrument.

In the case of implements the scheme of test did not appear to permit of measuring the actual disturbance of the soil (which is the essential factor) nor of pursuing the test to a comparison of the resulting yield of crop with a control plot.

The Report.—The Report has been prepared on much the same basis as the Report on the 1919 trials, although care has been taken to give additional details where these seem likely to be of service. A weakness appears to lie in the assumption made for calculating "comparative acres" ploughed per hour and other figures based on this unit. The assumption is that the resistance per square inch of furrow section varies directly as the depth of the furrow. This assumption is but tentatively made and Mr. Watson does not profess that the figures are strictly accurate: experiments recently carried out on behalf of the Ministry confirm Mr. Watson's experience that more energy is absorbed in displacing a greater depth of soil than a greater width. It would seem best, therefore, in the present state of our knowledge to avoid such an assumption as was made, unless indeed the factors to be employed in reducing all data to a common denominator are determined by *ad hoc* experiment. Unfortunately also the draw-bar horse-power results are open to question, since in the great majority of cases, as the Report

states, " both the maximum and sustained pull were less than the tractors were capable of exerting under normal conditions and on softer ground." Why this should have been it is not easy to say with certainty, although the hardness of the ground and the difficulty of penetration with spuds doubtless is a factor. The unsatisfactory nature of the results points to some modification of the test, since they are clearly valid in respect only of the exceptional conditions prevailing at the time and have no general application.

Mechanical Questions.—*Engines.*—The ordinary four-cylinder engine appears now to be almost in full possession of the field, but there seems to be an opinion that the six-cylinder engine may be introduced in the tractor on account of its greater steadiness of pull. The two-cylinder horizontal slow-speed engine still retains its position in some popular types. The Avance tractor was unique in one respect—it was the only two-cycle hot-bulb engine for burning crude oil, and the surprising cheapness of the fuel suggests that a more extended use of this engine may be expected in the future. The Avance had a certain crudeness of design, and vibrated violently on its springs when undergoing the test for belt horse-power, an effect which was no doubt due to the inevitable unbalanced forces of a single-cylinder engine. The irregularity of turning effort, in spite of the heavy fly-wheel, seemed to be reflected in the quality of the work done. The possibilities of an engine of this type for agricultural purposes are well worthy of consideration by manufacturers, and those who favour the slow-speed power unit in preference to the high-speed type may shortly be offered a further choice.

Pulleys.—One of the principal functions of agricultural tractors is to drive stationary machinery, and for this purpose they are fitted with belt pulleys. The variety of methods in which these pulleys are fitted is very wide. It is regrettable that manufacturers seem not entirely to appreciate the fact that it should be possible to manœuvre tractors readily into any desired position; this is especially the case when the drive is crosswise to the tractor. An instance occurred at the trials where a machine took as long as 41 minutes to obtain the correct alignment and as a consequence a time limit of 30 minutes was imposed. Designers should regard the placing of the belt pulley as being one of the most important subsidiary features on a farm tractor.

Wheels and Caterpillars.—But little attention appears to have been given to the essential problem of equipping wheels with suitable devices to give the maximum adhesion under all conditions likely to be met when field work may be required to be done: one of the greatest disadvantages of the present-day wheel equipment lies in the tedious methods which are employed for fixing or removing spuds. It should not be difficult to introduce methods which would dispense with this long and tedious operation.

The draw-bar tests showed decisively how ineffective most types were in giving satisfactory adhesion under certain conditions, and it is a matter of surprise that greater attention has not been paid to what is undoubtedly one of the principal factors in tractor efficiency.

The subject of caterpillar tracks is still very controversial. *Articles on this subject have appeared in previous issues of the *Journal* pointing out that investigation is necessary before any definite opinion can be formed as to the respective merits of caterpillar tracks and wheels. This view has been more than justified as the result of the 1921 trials. If the draw-bar test is to be taken as the criterion, the performance of the chain-track machines was exceedingly good, since they developed a high draw-bar horse-power, whereas the wheel machines could not develop a power commensurate with their rating; yet at the Lincoln trials under other conditions track machines failed where wheel machines succeeded. There is great need therefore of ascertaining precisely and conclusively the relative advantages of these two systems for different conditions. Progress would be facilitated if the following relations were known:—

(1) The bearing area and pressure distributed by wheels and tracks when the load is stationary and when in motion.

(2) The theoretical form of spud or strake best suited for various broad groups of soils to obtain the best possible hold on the ground during movement, taking into consideration the most important soil factors within the range of practical ploughing.

(3) The relationship between weight of the tractor and spud penetration.

The real issue is to design a series of spuds or strakes which will meet variable conditions in such a way as to use to the fullest extent a minimum tractor weight together with the minimum of energy and disturbance of the soil, secure the maximum sensible area of contact, and still keep within the shear value of the soil.

* See the issues of this *Journal* for October, 1919, and November, 1920.

Another difficulty which obtruded itself was illustrated by the fact that the Renault machine, weighing $3\frac{1}{2}$ tons when drawing six furrows, had a tendency to lift in front. The weight on the hind part of the tracks was therefore greatly in excess of that for which the machine was designed. This effect was of course due to the reaction of the driving torque on the rear axle, and this is much greater in caterpillars than in wheeled machines.

Generally speaking, caterpillar tracks have up to the present time been a source of some disappointment, especially to those who claim on theoretical grounds that a track-laying machine should have many advantages over wheel machines. So far, where comparative tests have been made, these advantages have not been strikingly manifested.

Weight Distribution.—Another matter which calls for attention is that of weight distribution and its effect upon slippage and guidance of tractors. Slippage of tractors of different types, with the same weight distribution and under practically the same conditions, varied materially. This would indicate that there are factors other than weight entering into the question which need investigation.

Power Rating.—As showing the wide differences between the powers of the engines fitted to the various machines, it is noted that the smallest engine is given as having been of 4.3 H.P. and the largest 45 H.P. on the rating of the Society of Motor Manufacturers and Traders. The highest maximum in the trial was the Hart Parr with 30 H.P. though the British Wallis was only a little way behind, while the lowest was 6 25 developed by the Service machine. The trial has indicated the wide variation existing in the rating of horse-power. A vital need is felt for a scheme standardising the power rating of tractors, as the present varying methods are unsatisfactory to manufacturers and users alike.

The trials demonstrated, as has been previously observed, that although ploughs and other implements have been modified with the object of taking advantage of the capacity of the tractor there has been no work of a fundamental character with a view, for example, to performing such work as ploughing at much greater speed than, and excellence equal to, that done by the horse plough.

The economical speed of mechanical traction is more than double that of the horse, and it appears that some of the most elementary factors influencing the question have not been rightly

appreciated. Empirically it is possible to evolve a mouldboard for a greater speed by increasing the length and pitch of the breast. The result would be the same quality of work at a greater speed. It is not, however, suggested that this would solve the problem, the magnitude of which is fully appreciated. In fact, before any really good design can be evolved it will be first necessary to carry out experiments on the relations between the design of cultivation implements and their effect on the soil. Investigation will have to be made on the lines of the effect of resistance in relation to such factors as speed, type of soil, moisture content, coupled with laboratory experiments into cohesion, plasticity and relative motion of soil particles over the mouldboard, the inversion of the furrow slice and other factors.

The problem is not one which concerns the tractor alone. It is by no means certain that the tractor represents more than a transitory method of applying power to agriculture. In many ways it is a clumsy and unsatisfactory unit, consuming in transporting its own bulk energy which should be employed in cultivation. A cheap and easily operated system of cable cultivation, whether by using internal combustion engines or electricity, crude oil or coal, may very well displace tractors: but the question of speed is as vital here as anywhere. We have been informed that with steam cable sets the economical speed for ploughing is about 3½ miles an hour, and that this is the limit because of the unsatisfactory nature of the work performed at higher speeds: but the ultimate survival of any system will depend upon the extent to which use is made of any special advantage which it offers.

Implements.—Little can be said of the actual performances of the implements, since the data collected do not take one very far, and the conditions were far from normal. The implement which attracted most attention was the Ransomes sub-soiling plough. It was to be regretted that the work done in the first field it entered was neither a satisfactory nor a typical exhibition. An attempt was made to sub-soil unnecessarily deep and a tine was employed which appeared to be too wide—although upon this point no definite opinion can be expressed without more experimental data than are at the moment at the command of the writers: the result, however, was that a heavy clay sub-soil was inverted. Better work was performed in rather lighter land, where a less arduous task was attempted: but far better work, indeed, from a mechanical point of view, perfect work has since been performed by this implement at a drainage demonstration

organised by the Ministry. Like the rest of the world, demonstrators learn by experience: and it may not be unnecessary to remind spectators, who may not have been impressed by the first exhibition of work, that the fault does not always lie with the implement.

The Ransomes Stubble Breaker and the A.B.C. Skim Plough are both designed to do work similar to the old Kent broadshare. The introduction of these implements is an indication that the tractor can be used to do work for which horses are unsuited: for there is little doubt that in many parts of the country the broadshare went out of use because, although a valuable implement for cleaning, it imposed too heavy a strain upon horses. Of the cultivators and harrows little need be said: generally they registered the advance which has been made in design and manufacture for tractor work of implements based upon horse-drawn models. The three types of Revolt excavator also mark the wide range of mechanical operations which the tractor has rendered possible. Since a fuller report on this type of implement is shortly to be expected from the Ministry, there is no need to dwell at length upon the performance at Shrawardine.

Conclusions.—The opinion expressed on previous occasions that the conditions under which trials are conducted do not give sufficient time or opportunity for adequate testing was confirmed by the 1921 trials. This is perhaps even more apparent with implements than with tractors. Sustained tests, which will extend to laboratory work on materials and soil samples, which will embrace durability and will on occasion be continued as far as the resultant crop, are not suitable as the basis for public demonstration. Of the value of trials such as these, however, primarily from the commercial and educative standpoint, the present writers are strongly convinced. It was gratifying, therefore, to see reappear a most interesting and well arranged exhibit of machinery and accessories. There can be no doubt that the combination of show-stand and demonstration is the most satisfactory, indeed the only satisfactory, way in which the manufacturer can exhibit his products to the farmer.

SOME ASPECTS OF AGRICULTURAL EDUCATION IN THE UNITED STATES OF AMERICA.

L. K. ELMHIRST, M.A. (Cantab.), B.Sc. (Cornell).

AGRICULTURE of all industries in the United States has been from the earliest days the largest and the most important. The rapid development of factory production and city life, dependent upon a home-grown food supply, has of late raised problems in American rural life which have compelled widespread attention. The higher wages of the city and the demand for an increase of food production during the War did not improve matters, since slowly but surely the countryside was being sapped of its best stock. The farmers' sons were moving into the cities and labour was almost impossible to obtain. In the words of the Director of Agriculture for New York State:—"Chief among our rural problems is the creation and the maintenance of an environment on the farm and in the farm home such that a fair proportion of intelligent and able American citizens will continue to earn their livelihood from the land."

New York State, with the conditions of which we shall deal in this article, has probably made as much progress in dealing with this problem as any other State in the Union. Except that its summer is hotter than ours and its winter more severe, agricultural practice is very similar to that in England The size of the average farm ranges between seventy and three hundred acres. Maize silage takes the place of roots in dairying. The large cities, New York, Buffalo, Rochester, Albany and Syracuse demand an ever-increasing supply of fresh milk and vegetables, and of butter, fruit and potatoes. Beef, mutton, pork, horse flesh and grain can all be grown on a large scale and at less cost in the West; cotton, sugar and tobacco in the South, and all these can be shipped long distances without deterioration.

Already in 1862 the necessity for technical training and scientific study in the field of Agriculture was recognised at Washington, when the Morrill Act was passed by the Federal Government. This Act provided funds and land for the establishment of State Agricultural Colleges. In 1865 Ezra Cornell founded the University, named after him, at Ithaca in New York State, and the State College of Agriculture was added to it some years later. From the first, under the leadership of such men as Dean Roberts and Dr. Liberty Hyde Bailey, the policy of this college was to

act as help and friendly guide to the farmers in all their problems and difficulties. In 1890 the Morrill Act was modified and the necessary funds added to allow for the special preparation of instructors for teaching the elements of agriculture in schools and technical institutes.

It was not until 1909 that any decided attempt was made on the part of the different States to introduce the teaching of agriculture into the State High Schools which correspond to the National Secondary Schools in England. In that year the State of New York passed a law encouraging local communities to undertake the teaching of vocational agriculture in the High Schools. A few schools were established about the same time which were entirely devoted to the teaching of agriculture. In 1912 the Federal Government at Washington again came to the aid of the farmer and, dispensing with the existing educational machinery, passed the Smith-Lever Act. Upon the fulfilling of certain conditions by the different States, this Act voted a large sum "To aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics and to encourage the application of the same." In New York State this fund has made possible the building of a bridge between the farmers and the Research work carried on at the Agricultural College in Ithaca, at the Experiment Station in Geneva, N.Y., and at the U.S. Department of Agriculture.

The extension of work thus initiated has developed along two main lines, both outside the State educational machinery:—the provision of lectures dealing with specific problems of practice and business on the farm and in the farm home, and the establishment of a system of Junior Extension amongst the boys and girls up to the age of 14 whilst still attending the elementary schools. The first line never developed into systematic courses of instruction but was generally carried out by professors or instructors of the University on tour. All arrangements were made by the County Agents of whom there is one to each County. The second has developed, largely owing to the stimulus of the War, until there are now County Junior Extension Leaders in sixteen counties in New York State. Under the influence of these leaders and with the help of the County Agent, the boys and girls are formed into Clubs under local, and often untrained leadership, which engage in poultry keeping, gardening, fruit canning or cooking. There are now some 1,200 of these local leaders in New York State drawn from the rural school teachers,

from old graduates of the College of Agriculture and of the short courses held regularly at Cornell University, or from the teachers of vocational agriculture. In one county 1,600 boys are enrolled.

Until 1917 Agricultural Education in America was almost confined to the courses in the Land Grant Colleges, the occasional lectures to farmers and their wives on special subjects and the Club work made possible by the Smith-Lever funds. In 1917 the Smith-Hughes Act was passed by Congress at Washington.

The Smith-Hughes Act is again a gesture of impatience by the layman at the hide-bound activities and machinery of some of the State Boards of Education. It was the outcome of pressure by a group of manufacturers, a number of Labour organisations, the farmers' representatives at Washington and a Conference of Domestic Science Teachers. The Act provides:—"For the promotion of vocational education; to provide for co-operation with the States in the promotion of such education in agriculture and the trades and industries; to provide for co-operation with the States in the preparation of teachers of vocational subjects; and to appropriate money and regulate its expenditure." For the paying of salaries of teachers, supervisors and directors of agricultural subjects alone $500,000 was set aside in 1918. This sum will have increased annually until in 1926 it will amount to $3,000,000. It is allotted to States in the proportion which their rural population bears to the total rural population of the United States. In the same way by 1926 $3,000,000 will be devoted to the training of teachers, supervisors and directors in trade, home economics and industrial subjects. Every year an additional $1,000,000 is set aside for the salaries of teacher trainers.

The scheme may well be termed a lay experiment in education, for the Commissioner of Education at Washington is only one of the Federal Board which also includes the Secretaries of Agriculture, Commerce and Labour together with three citizens representing respectively the manufacturing, commercial, agricultural and labour interests of the Nation. In the States the composition varies greatly. In a few the educational authorities were excluded altogether from the State Board, which consisted entirely of laymen. It was felt that the Boards of Education would not only fail to make a move in order to fulfil the necessary conditions and to draw the Federal grant, but that they might be definitely opposed to the setting up of such unacademic courses. In New York State the scheme is run by the Board of Education in close harmony with the Board of Agriculture and in co-operation with the State College of Agriculture, where the teacher

training work goes on, and which forms the main source for the supply of graduates for the work.

For the year 1921 New York State alone will draw a total of $412,906 by fulfilling certain conditions. It has, for instance, to appoint a State Board, which may or may not include the Commissioner of Education, and to match dollar for dollar from its own or local funds. The principles lying behind this kind of grant are the following. It is held that if an individual or a community desires a thing strongly enough it will be willing to pay for it; that an individual or a community values most highly and cherishes most carefully the thing in which it has made an investment, and that Federal or State aid is for the purpose of assisting a community and not of making it a gift. The cost of establishing these Departments of Agriculture and of running and equipping them falls upon the State and the community or board which has made the initial demand. Already in 1920 there were seventy of these Departments in High Schools in New York State.

In the words of the State Director of Agriculture:—" A high school department of vocational agriculture is but a part of an organised nation-wide movement to promote better farming, better business and better living. Instruction in such a department means more than an attempt to turn back to the farm the tide that flows cityward or to induce children to stay in school, although these are natural outcomes of such instruction. The true purpose of agricultural education is to fit for agricultural pursuits those who may cast their lot with the farm. It is based on the recognition of the dignity of labour and the necessity for practical experience in the attainment of a well-rounded education. While emphasising training in the skill and knowledge necessary to control plant and animal production such education includes the usual instruction in English, history, economics, science and mathematics which every boy should receive in preparation for social efficiency and leadership in rural affairs."

These departments form therefore an integral part of the secondary school system of the State. The course is voluntary but the pupils are still directly under the administration of the Principal. Their establishment depends upon local initiative, more especially from the farmers themselves. The following particulars have to be provided:—the number of boys in the academic department of the existing High School, the number of boys residing on farms, the registration of boys in the grammar grades of the rural elementary schools tributary to the high

school, the demand for instruction in vocational agriculture, the total assessed valuation of the school district, and the extent to which farmers will co-operate in promoting the work of such a department of agriculture. The Board of Education of any city can establish such a department on its own initiative but in a union free or a common school district the question has to go before an annual or a special district meeting. With every department of agriculture is established a department of "home making" or domestic science for girls. When the resolution is once passed arrangements are immediately made for the raising of the necessary local funds. The minimum requirements made by the State for such departments of agriculture include the following: There must be provision for at least six months of directed or supervised practical work. The course must take into special account the types of farming dominant in the neighbourhood. Two rooms and a library of books, bulletins and journals must be provided. The teacher must be enabled to attend certain conferences. There must be an enrolment of not less than twelve boys and at least fifty dollars must be set aside for the travelling expenses of the teacher in order that he may carry out what is the most important part of the work, the close supervision of the practical work, the "farm enterprise" or "home project."

Provided that the Federal demands are fulfilled the salaries of the teachers run on a sliding scale according to the amount which the Local Community is willing to contribute. In all cases the State contribution is $1,000. If the Local provision is only $200 the Federal grant is $200 also, if the Local grant is $533 the Federal grant is $866. This means that the salaries range between three and six hundred pounds per annum.

To merit such a salary as this last, sometimes in excess of that of the High School Principal himself, stringent qualifications are required. The teacher must have an authorising certificate showing graduation from a four years High School and a four years Agricultural College course. Ten per cent. of his college work must have been concerned with educational psychology, principles and methods. He must be approved by the staff of the Teacher Training Institution, which is always consulted over the matter of choice of teachers. He must be thoroughly conversant with farm life and with work on a farm. In any case his College Degree is conditional upon his having done a year's work as a farm labourer. He must have a good general knowledge of the entire field of agricultural subjects common to New York State,

including animal husbandry, dairy husbandry, poultry husbandry, soils, farm crops, vegetable gardening, fruit growing, plant diseases, entomology, farm management and farm machinery. In addition he should have specialised in some phase of technical agriculture. He should be able to connect the school work with the home work of the pupil on the farm and possess skill in the use of carpentering tools and in farm repair work. The local board of education or school committee is obliged to appoint an advisory board in the district to give advice on local farm conditions, to help to organise the " farm enterprise " work described below and to promote the success of the department by encouraging visits to their farms or by delivering practical talks.

Two courses are given, one of two and the other of four years. Many boys still leave the elementary schools at fourteen and return straight to the land. Under the new Compulsory Continuation Law of New York State, all boys and girls will stay in the High School till eighteen as soon as the necessary educational machinery has been erected.

The following is a tentative course of study for a certain district in New York State :—

First Year Agriculture:
- Farm Shop Work.
- Poultry Husbandry.
- Home Gardening.

Second Year Agriculture
- Farm Crops.
- Soils and Fertilisers.
- Home Gardening.

Third Year Agriculture:
- Animal Husbandry.
- Fruit Growing.
- Dairying.

Fourth Year Agriculture:
- Farm Management and Economics.
- Farm Engineering and Machinery.

The accommodation at the school consists of two rooms, and if possible an experimental plot. The first room serves as laboratory and class room and contains the library, charts, papers, soil and milk testing equipment. The second room is the workshop where the boys are taught how to sharpen all farm tools and saws, to do farm repair work and elementary construction in wood, to do cold metal work of all kinds, to solder, to glaze, to mend harness and to do elementary plumbing. Simple mechanical drawing is also taught and the experimental incubator is generally housed in this room.

Of the seventy-two counts required for an academic diploma which will admit the boy to the State Agricultural College, sixteen must be gained in English, ten in science, ten in mathematics, ten in history and at least twenty-five in agriculture. For a successfully completed " Farm Enterprise," most of which

will have been carried out in out-of-school hours at home, counts are also given. In conjunction with the above course the major enterprises for the first year would probably consist of (i) the sole charge of twenty to a hundred hens, with the rearing of chickens, the keeping of a complete set of accounts, the purchase of feed and the marketing of the products, or (ii) the care of a quarter to half an acre of garden, again with full accounts. In the second year both of these would be kept on and an acre of some farm crop added, in the third a pure bred dairy calf to be reared to maturity and fed and cared for scientifically, and in the fourth perhaps a complete set of farm accounts. Such "enterprises" or "home projects" are now regarded as the most vital part of the training and are often, when properly supervised, an education in themselves. Special time is allotted in the class room for the discussion of problems which come up week by week in the project at home and also for the visiting by all the other boys of the different enterprises. In all cases the boy pockets the profits after paying his bills.

What the future development of this educational experiment will be it is impossible to say, but it was fascinating to watch the formal lecture being replaced by the round table discussion and to see the eagerness with which all the available text books bearing upon the boy's enterprise were devoured as well as the keen desire to launch out into the fields of chemistry, physics, botany, zoology, entomology and physiology in order to find a solution to the problems of daily existence.

THE VALUE OF FOOD RECORDS IN CONNECTION WITH MILK RECORDING SOCIETIES.

G. H. GARRAD,
Agricultural Organiser for Kent.

EVER since the formation of the Kent Milk Recording Society the members of the Society have had the opportunity, whenever the milk recorder paid them a visit, of having the winter rations fed to the cows weighed and particulars forwarded to the agricultural organiser for criticism and advice. It is the object of

this article to show that such food records are of distinct value to the farmers belonging to the Society in enabling them to correct and to reduce the cost of feeding, and that the practice could be extended to milk recording societies in other counties with considerable advantage.

The cost of taking the food records is nil. The milk recorder visits the farm in the course of his ordinary duties and he usually has ample time, in addition to seeing the milk of each cow weighed, and marking the calves, to weigh the concentrated foods that are being used and to get at any rate a rough idea of the quantity of roots and fodder that is being fed. The prices of the various feeding stuffs are obtained from the farmer, and this information, with the number of cows in milk and the quantity of milk they have given in the day, is forwarded by the milk recorder to the agricultural organiser. The agricultural organiser calculates the cost of the ration and its composition, compares the ration with the scientific requirements of the cows, and sends the completed figures back to the farmer with his criticisms and suggestions as to how improvements might be effected.

During the winter 1920-21 every farmer was invited to put his own cost-of-production prices on his roots, hay and straw, other feeding stuffs being taken at the actual prices paid for them, and these figures were used in getting out each farmer's return for his own information; but for comparing one farmer's results with another it has been found desirable to charge the same cost per ton for roots, hay, straw, etc., in every case. The prices agreed upon were as follows:—

	£	s.	
Hay	7	0	per ton.
Straw	3	10	per ton.
Mangolds and Cabbages	1	10	per ton.
Swedes	2	5	per ton.
Cakes and Meals at purchase price.			

The above prices have been used for every farm and for every visit in the calculations embodied in this article.

Between November 20th, 1920, and April 15th, 1921, eighty-eight food records of herds on their full winter ration were submitted by members of the Kent Milk Recording Society, through the milk recorders, to the agricultural organiser in order that the cost and composition of the ration might be worked out and the same criticised. The food records from some farmers were only submitted once in the course of the winter; in other cases farmers submitted their food records

twice, three times, and in one case four times during this period, as the following figures show:—

Food Records taken:—	*No. of Herds.*	*No. of Cows.*
Once	27 ...	560
Twice	18 ...	386
Three or more times	8 ...	120
	53	1,066

As soon as possible after each visit of the milk recorder a return is sent by the agricultural organiser to the farmer concerned, showing the cost of his ration, its composition as compared with the scientific requirements of the cows, and any criticisms or suggestions as to how the ration might be improved or reduced in cost.

A complete statement was sent out to every farmer belonging to the Society in January, and again in April, showing figures for all the herds under the following headings:—Code number of herd; date of visit; number of cows in milk; day's yield of milk per cow; cost of food per cow; cost of food per gallon of milk; quantity of roots, silage, wet grains, hay, straw, cakes and meals fed per cow; amount of digestible protein and starch equivalent in the day's ration for each cow; the scientific requirements of average-sized cows, in terms of digestible protein and starch equivalent, giving the quantity of milk quoted. From these figures every farmer is able to compare his own ration and results with those of any other member of the Society.

Taking an average of the whole of the 88 food records received, the following results are obtained:—

	Average.	*Extremes.*
No. of cows in herd	19	2 to 82
Daily yield per cow per day—lb. of milk	22·05	11·06 to 34·56
Cost of food per cow per day—pence	32·26	17·63 to 54·00
Cost of food per gallon of milk—pence	15·13	7·73 to 26·22
Daily ration in lb.—Roots	52	0 to 124
Wet grains... ...	5	0 to 40
Silage	2	0 to 45
Hay	9½	0 to 28
Straw	6½	0 to 22
Cakes and Meals ...	7½	2 to 17

As in previous years, there has been a remarkable variation on different farms in the average milk yields of the cows, the cost of food per cow per day, and the cost of food per gallon of milk.

The yield of milk per cow per day is now recognised by the best farmers as an important factor influencing the cost of food per gallon of milk, yet there are still some farms where the milk yield ranges round 1½ gallons per cow.

Herd.	*Date of Visit.*	*Yield of Milk per cow per day.*	*Cost of Food per gallon.*
		lb.	pence.
AV	Feb. 1	11·61	22·62
J	Dec. 8	15·03	19·27
BQ	Feb. 22	22 78	14·39
BP	Feb. 18	31 47	12·11
BI	March 18	34·56	9·80

Similarly there has been an enormous variation in the cost of food per cow per day :—

Herd.	*Date of Visit.*	*Daily ration per Cow.* *Roots.*	*Fodder.*	*Cakes & Meals.*	*Cost of Food per Cow per day.*
		lb.	lb.	lb.	pence.
AQ	Dec. 22	nil	18	2	17·63
AL	March 9	40	16	6½	24·58
AD	Jan. 5	60	14	7½	31·40
AT	Jan. 4	101	19½	5	37·52
BB	Dec. 4	62	10	17	43·74
G	Dec. 9	73	10	16½	49·24
BF	Nov. 19	124	17	12	54 00

In all cases, it must be remembered, roots, hay and straw have been valued at the same price per ton. Every farmer has almost equal opportunities of buying concentrated feeding stuffs at the same prices; yet the cost of the ration has varied from less than 1s. 6d. per cow per day in one case to more than 4s. per cow per day in another. The quantity of milk a cow is giving should determine to a large extent the amount of food it receives, and in many herds each cow is now being fed according to the quantity of milk it gives, but several cases were found where herds as a whole were being grossly over-fed and other cases where they were being grossly under-fed.

The important figure, from the farmer's point of view, is the cost of food per gallon of milk. This figure has varied on the different farms as much as the other figures already quoted :—

Herd.	*Date.*	*Cost of Food per gall. of milk.*
		pence.
BP	April 10	8·30
A	Nov. 22	10·37
AN	Dec. 17	15·56
BA	Dec. 18	21·43
BD	Dec. 31	25·21
BF	Nov. 19	26·22

There was one extreme case where the cost of food per gallon of milk worked out as low as 7.73 pence per gallon, but this figure has been ignored as the cows were obviously being very seriously under-fed.

It will be noticed that the cost of food per gallon of milk was more than three times as great on one farm as on another. A criticism might be made that on April 10th herd BP was probably on a summer ration, but the ration actually being fed was 34 lb. of mangolds. 26 lb. of wet grains, 7 lb. of hay, 4 lb. of straw and 5½ lb. of mixed cakes and meals. The milk yield was high, 31.92 lb. of milk per cow as compared with 31.47 lb. of milk per cow on the same farm on February 18th. Herd BF was a herd that was being seriously over-fed. The cows were only averaging 20.60 lb. of milk and their ration consisted of 120 lb. of roots, 10 lb. of hay, 7 lb. of straw and 12 lb. of cakes and meals.

This enormous variation in the cost of feeding on different farms is not peculiar to one season; it occurs year after year. In the previous winter (1919-20), for example, eighty-six food records were submitted to the agricultural organiser, and the cost of feeding per cow per day varied from 1s. 5d. in one case to 4s. 6d. in another. Similarly, the cost of food per gallon of milk varied from 9½d. to 2s. 2½d. in different herds. In that season hay was priced in every case at £7 per ton, straw at £3 10s. per ton, mangolds and cabbages at 30s. per ton. and swedes at 45s. per ton. It is evident that every year there are a large number of dairy farmers to whom a food record taken in the way already described would be of immense assistance. Heavy cost of feeding is usually due to one or more of four causes:—

(A) *A Low Milk Yield on the part of the Cows.*—A simple calculation shows that the more milk a cow gives the cheaper becomes the cost of food per gallon, because a four-gallon cow does not require twice as much fodder or roots as a two-gallon cow—a double allowance of cakes and meals will usually suffice. The most economical herds are those that yield well on a normal ration. This is a matter mainly of breeding and selection, and one of the main objects of a milk recording society is to show the members which of their cows produce the most milk, so that these cows may be used as foundation cows, put to a bull of good milking strain and the heifer calves reared.

(B) *Extravagant Feeding.*—The writer's experience is that over-feeding is a more common fault than under-feeding, though many cases of under-feeding are met with. Over-feeding occurs in several forms. Frequently it takes the form of an excessive allowance of hay, farmers forgetting that £7 per ton for hay is equivalent to ¾d. per lb. and that 28 lb. of hay at that price costs 1s. 9d. More often it takes the form of excessive feeding of concentrated foods. In one case last winter ten cows were receiving a daily allowance of 170 lb. of cakes and meals, an average of 17 lb. per cow, although they were each giving only 2 gallons of milk. This quantity of concentrated food would have been more suitable for 5-gallon cows than for 2-gallon cows. The practice of measuring out the supply of concentrated foods to each individual cow according to her milk yield is year by year becoming more prevalent and is being encouraged in every possible way.

(C) *Indiscriminate Purchase.*—The relative market prices of the concentrated feeding stuffs during the past winter were in many cases in marked contrast with their feeding values. Farmers are far too prone to be guided by their cake merchant in making their selection of what they will buy, or to buy their old favourite feeding stuffs of pre-war days regardless of present market prices, instead of comparing the market price with the feeding value of the feeding stuff with the help of such a table as is published in this *Journal* month by month.

(D) *Bad Management.*—No amount of scientific feeding will be successful unless both the farmer and his cowman take an intelligent interest in the welfare of the cows.

Most of the farmers consider that two food records taken during the course of the winter are sufficient, but the following figures show that those farmers who had three food records taken were able to produce milk still more cheaply than those who had two food records taken, whilst those who had two food records taken produced milk more cheaply than those who only had one record taken, assuming that the latter did not alter the rations that they were feeding. A comparison between the composition of the rations being fed with the scientific requirements of the cows is also enlightening :—

Food Records taken.	*Cost of Food per gall.*	*Composition of Ration fed.* *Digestible Protein.*	*Composition of Ration fed.* *Starch Equivalent.*	*Scientific Requirements of Cows.* *Digestible Protein.*	*Scientific Requirements of Cows.* *Starch Equivalent.*
	pence.	lb.	lb.	lb.	lb.
Once ...	15·71 ...	2·45 ...	13·28 ...	2·10 ...	12·91
Twice ...	15·13 ...	2·28 ...	13·14 ...	2·08 ...	12·90
Three times	14·53 ...	2·29 ...	13·02 ...	2·20 ...	13·30

The scientific requirements of an average-sized Shorthorn cow have been taken as 7.50 lb. of starch equivalent, including 0.84 lb. of digestible protein for her maintenance ration, and an additional 2.50 lb. of starch equivalent including 0.58 lb. of digestible protein for every gallon of milk. It will be noticed that, on the average, the 27 farmers who had only one food record taken were over-feeding their cows, assuming the scientific requirements of the cows to be correct. The 18 farmers who had two food records taken had the opportunity of correcting their rations, with the result that their feeding on the average of the two food records taken corresponded more nearly with the scientific food requirements of the cows, whilst the rations of the eight farmers who were criticised three times are still nearer in line with the scientific standards.

The following figures show a comparison of the first food records with the second food records of 23 out of the 26 farmers who have had two or more food records taken during the course of the winter. The food records of three farmers whose herds consisted of only 2, 4 and 5 cows, respectively, and were therefore too small to provide reliable figures have been disregarded :—

	1st Food Record.		*2nd Food Record.*
Number of Cows	505	...	481
Daily yield per cow per day—lb. ...	20·79	...	22·58
Cost of food per cow per day—pence ...	33·39	...	31·00
Cost of food per gall. of milk—pence ...	16·06	...	13·73

These figures show that at the time the second food record was taken 481 cows were producing daily 1,086 gallons of milk (2.26 gal. each) at nearly 2½d. per gallon less cost than at the time the first food record was taken.

A saving of 2½d. per gallon on 1,086 gallons of milk amounts to £11 6s. 8d. per day or £2,058 17s. 6d. in the six winter months. These are the results from 23 herds only. There were 27 other herds which had their food records taken once but not twice, so that no information is available as to the extent to which they profited from the taking of the food records. The reduction in the prices of cakes and meals as the winter proceeded assisted in reducing the cost of feeding, but this effect was small because in most cases the concentrated foods were charged at the same price on each subsequent visit of the milk recorder as on the first visit. It is therefore evident that food records as well as the milk records and the information obtained from them are distinctly helpful to the dairy farmer. In the writer's opinion the taking of food

records should be an integral part of the Milk Recording Scheme. In Denmark, a country one-third the size of England and Wales but with four times as many milk-recorded cows, the milk recorders not only weigh but also analyse the milk of each individual cow at every visit—and the cows are milked three and occasionally four times a day—and still find time to take the food records. There are no surprise visits, so that the transport by the farmer of the milk-testing apparatus can be more easily arranged, but there seems no reason why in this country the usefulness of a milk-recording society should not be increased by utilising the services of the milk recorder when he arrives on a farm in taking the weights of the foods as well as of the milk at every visit.

LIME-SULPHUR AND CALCIUM CASEINATE AS A FUNGICIDE.

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ABOUT the year 1910 lime-sulphur as a summer-wash was being confidently advocated in the United States. In this country fruit growers first turned to this new fungicide in the expectation that it might prove superior to Bordeaux mixture for the control of apple "scab," and, later, as the best wash available for fighting the recently introduced American gooseberry-mildew.

The history of the early use of lime-sulphur is largely recorded in the pages of this *Journal*. In 1910 and 1911 articles appeared (1) (2)* giving instructions for making the best lime-sulphur wash and for the standardisation of its strength, as well as the results of the first spraying experiments on apples and on gooseberries. It soon became apparent, in further experiments (3) (4) (5) that serious injury—in the form of defoliation—is caused to certain varieties of gooseberries by lime-sulphur at the standard "summer strength." Further, owing to the fact that the lime-sulphur wash when used alone does not "run" well, but dries in blotches which are remarkably adhesive and are not washed off by rain, serious disfigurement of dessert gooseberries results if the berries are sprayed during the later stages of ripening.

* These and subsequent numbers are references to the Bibliography at the end of this article.

A closely allied wash, ammonium polysulphide, discovered in 1916 (6) (7) (8), which leaves no visible deposit on the sprayed parts, can be recommended for the purpose, but this wash is in disfavour with the manufacturing horticultural chemist, owing to the difficulties met with in its preparation.

With regard to the use of lime-sulphur as a summer-wash on apples for the control of "scab," the expectation (raised by reports from the United States) that it would control this disease as well as Bordeaux mixture does, and without causing any injury to the tree, has not been fulfilled. Not only may serious defoliation result on certain varieties (*e.g.*, Stirling Castle, Newton Wonder) after spraying with lime-sulphur, but, according to the experiments (9) (10) lately carried out at the East Malling Research Station, a reduction of crop (due to the young apples falling off) may be caused.

In view of the above facts, it is obviously a matter of great practical importance to ascertain as closely as possible the exact strength of lime-sulphur which is necessary to kill the fungus. in order to see whether any of the ill-results which now follow the use of lime-sulphur under certain circumstances can be avoided by using it in a weaker solution. Although much work has been done in the orchard and plantation in spraying trees with lime-sulphur solutions of various strengths, it does not appear that carefully controlled biological observations on the sprayed fungus—such as can be made on plants grown under glass—have hitherto been recorded. The present article describes the results of experiments which have determined the strength of lime-sulphur necessary to kill the "summer," or *conidial*, stage of one of the "powdery" mildews, viz.. the Hop-mildew (*Sphaerotheca Humuli* (D.C.), Burr.).

Description of Experiments.—The plants used in the spraying experiments were young hop-plants, grown in a greenhouse, infected with the hop-mildew. In previous work (11) it had been found that the mildew in different stages of development shows very different powers of resistance to the same fungicide. By the selection of only those patches of mildew in the same stage of development. *i.e.*, the so-called "powdery" patches of the conidial stage,* and on young vigorously growing leaves, it is possible to keep a sufficiently fixed standard by which to measure satisfactorily the fungicidal value of different solutions.

If a lime-sulphur solution—even in the finest possible "misty" spray, such as that given by an "atomiser"—is

* An illustration of this stage is given in the article by *E. S. Salmon*, "Hop-mould and its Control" (*Jour. Min. Agric.*, May 1921, p. 150, Fig. 2).

sprayed on to a "powdery" patch of mildew, it will be found that the fluid congregates in minute drops over the surface of the patch, so that it becomes impossible to measure accurately the fungicidal effect of the fluid, since parts of the fungus remain unwetted. It is necessary, therefore, either to treat the mildew with some substance such as a soft soap solution which will cause it to be wetted all over by the lime-sulphur wash applied subsequently, or to add some substance to the lime-sulphur which will increase its wetting properties. Both these lines of investigation were followed and gave remarkably concordant results.

In one set of experiments the patches of mildew were sprayed first with a 1 per cent. solution of soft soap (which removed the air entangled among the *conidia* and *conidiophores*, and wetted all the parts), then with water to remove the soap solution, and immediately afterwards with the lime-sulphur solution. After the treatment with soap and then with water, it was found that the mildew had not been appreciably affected, since by the fourth day after spraying the mildew-patches were fully as vigorous and as "powdery" as the unsprayed ones on the "control" leaves, and also that the lime-sulphur solution when applied to the wet mildew-patch no longer collected on it in drops, but ran through and wetted thoroughly each "powdery" patch.

Using this method, it was found that a commercial brand of lime-sulphur, of 1.30 sp. gr., containing 16.57 per cent. of polysulphide sulphur, when diluted 1 part to 99 parts of water and thus containing 0.16 per cent. of polysulphide sulphur, was fungicidal. By the fourth day after spraying all the mildew patches on the sprayed leaves (although still conspicuously white and little altered to the naked eye) were quite dead, while the "control" leaves (at the same "nodes") which had been sprayed only with the soap solution and then with water, bore vigorous, densely powdery patches of mildew.

Using the dilution of one part of the same concentrated lime-sulphur to 199 parts of water, or 0.08 per cent. of polysulphide sulphur, it was found that while the majority of the patches of mildew were killed, a few survived; in other words, lime-sulphur at this strength was apparently just beginning to break down as an efficient fungicide.

The preliminary treatment of the mildew with soap and then with water, while useful for experimental purposes, cannot of course claim to have any practical value.

In the experiments, where a substance was added to lime-sulphur in order to increase its wetting powers, calcium caseinate was found to give very satisfactory results. This substance, which has been used by A. Peterson (12) in conjunction with lime-sulphur as an insecticide, has not hitherto, we believe, been used for improving lime-sulphur as a fungicide for use in summer. It may be mentioned here that the substance known as saponin considerably increases the wetting properties of lime-sulphur (13) but the mixture was not found satisfactory for determining the fungicidal values of lime-sulphur solutions, whereas calcium caseinate gave admirably consistent results. In the first experiments 1 per cent. of calcium caseinate was used with lime-sulphur (1.30 sp. gr.) at the dilution 1 : 99, 1 : 149 and 1 : 199, containing, respectively, 0.16, 0.11 and 0.08 per cent. of polysulphide sulphur. At the first two strengths, the solution proved fungicidal, all the patches of mildew on the sprayed leaves being dead when examined 24 hours after spraying, while the mildew-patches on the "control" leaves, sprayed with 1 per cent. of calcium caseinate alone were as vigorous as before. At the strength 1 : 199, the lime-sulphur solution was clearly not quite fungicidal—many of the patches were killed but several survived and produced new *conidiophores* and chains of *conidia*.

In another experiment the same lime-sulphur was used at the dilution 1 : 99 with 0.5 per cent. of calcium caseinate, and here again proved completely fungicidal.*

It seems probable, therefore, that the strengths at which lime-sulphur is being used in this country against mildews, viz., 1 part of the concentrated wash (1.30 sp. gr.) to 29, or 59, parts of water are to be regarded as super-fungicidal and that weaker strengths, viz., 1 to 74, or 1 to 99, will be found to be fungicidal when used with calcium caseinate in order to secure complete wetting.† Should this prove to be the case, and with regard to

* In one experiment a calcium polysulphide solution, made in the laboratory, was used at the dilution 1 : 75 (when it contained 0.33 per cent. of polysulphide sulphur) with 1 per cent. of calcium caseinate and found to be completely fungicidal.

† The calcium caseinate solution was prepared by stirring two parts of commercial casein and one part of slaked lime in twenty parts of water for about two hours and allowing any undissolved solid to settle. The supernatant liquid, used without filtration (which is extremely slow and unsatisfactory), is, roughly, a 10 per cent. solution of calcium caseinate, and half a gallon or one gallon of it is used in the preparation of ten gallons of lime-sulphur wash according as one desires to have 0.5 or 1 per cent. of calcium caseinate present. The preparation by the farmer of the calcium caseinate solution would be a tedious process; it is confidently expected, however, that this substance will be put on the market in this country by manufacturing horticultural chemists, as a similar substance, for use with arsenate of lead, is sold commercially in the United States of America.

apple "scab" also, a way may possibly be found to avoid the serious injuries produced by lime-sulphur at higher strengths on the apple and gooseberry.

Summary.—In carefully controlled experiments it has been found that lime-sulphur at a strength of 1.003 sp. gr. (1 gal. of the concentrated wash (1.30 sp. gr.) to 99 parts of water) and containing 0.16 per cent. of polysulphide sulphur, is lethal for the "powdery" conidial stage of the hop-mildew,* when the lime-sulphur is used with calcium caseinate in order to secure complete wetting of the fungus.

It is considered probable that lime-sulphur at this strength and mixed with calcium caseinate will be found lethal for the American gooseberry-mildew also (and other "powdery mildews") and that at this dilution lime-sulphur may be used on ripening dessert gooseberries without fear of disfiguring the fruit for market.

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* It must be pointed out that under practical conditions "flowers of sulphur," and not lime-sulphur, is to be recommended for use against hop-mildew. (See *Salmon, E. S.*, "Hop-mould and its Control," (*Jour. Min. Agric.*, May, 1921, p. 150).)

TRANSPORT OF STRAWBERRIES FROM THE CHEDDAR VALLEY.*

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A branch line of the Great Western Railway from Yatton to Wells serves the Cheddar Valley district, and the three principal stations, at which fruit is loaded are Cheddar, Axbridge, and Draycott. The bulk of the fruit is dispatched to market by rail, but a small quantity is conveyed to Bristol by road, and an appreciable quantity meets a ready retail sale to the numerous motor-coach parties and visitors to Cheddar Cliffs and Caves. It is estimated locally that during last season between forty and fifty tons have reached Bristol by road, and about thirty tons were sold to visitors at Cheddar.

Railway Arrangements.—The Great Western Railway Company provide special facilities for strawberry traffic, during the season, at Cheddar, Axbridge, and Draycott Stations, and a special fruit train is run when at least six vans can be filled with fruit. The Cheddar Valley Fruit Growers' Association practically controls the available railway transport, and has a strong Committee of growers, which meets nightly during the season. The usual business is to decide (1) whether, in the opinion of the growers, the supply of fruit will warrant a special train the following day, in which case the Secretary of the Association notifies the station master at Cheddar, and (2) after discussion of ruling prices, the destination of the following day's crop. Non-members of the Association, who wish to take advantage of the through vans, are thus forced to consign to the same markets as the Association. Smaller consignments for other markets are dispatched by ordinary passenger trains.

In all nine special trains were run last year. The heaviest dispatch was on June 6th, when twenty-one tons of fruit left the Cheddar Valley. Special facilities are accorded by the railway company for quick transit, to ensure prompt arrival at the early morning markets.

Types of Vans in Use.—There have been four types of van in use on the Cheddar Valley Line :—

(*a*) A large ventilated van on eight wheels called a "Siphon C" (Fig. 1). This has two rows of shelves suspended by chains on each side

* See "Strawberry Growing in the Cheddar Valley of Somerset," *A. D. R. Walbank*, this *Journal*, Jan., 1921, p. 911.

FIG. 1.—Interior of large ventilated "Siphon C" Railway Van

FIG. 2.—Interior of Railway Fruit Van "D"

FIG. 3.—Method of handling Strawberry Chips.

of the van, and is fitted with a concrete floor. It is about 60 ft. in length, and when packed with chips one layer deep on floor and shelves, will hold about three tons. Probably this is the easiest van to pack, but its capacity is limited, compared with its length.

(*b*) A van known as Fruit Van "D," convertible for other purposes (Fig. 2). This is a van entirely filled with four layers of wire shelves in sections, and when the shelves and floor are filled with chips one layer deep, it will hold from 44 to 48 cwt. Probably this is the most economical van but it is rather more difficult to pack. Its great advantage is that it does not permit the chips to be "topped." The van is ventilated.

(*c*) An ordinary milk siphon van with lattice sides and fitted with wooden shelves. Capacity in single layer about 30 cwt.

(*d*) A small enclosed ventilated fruit van with wooden shelves. Capacity about 1 ton.

Method of Packing.—Nearly all fruit from the Cheddar Valley is marketed in 4 lb. chips. Punnet cases to hold thirty-two 1 lb. punnets are occasionally seen, but these are used only for fancy fruit. Although in some districts the total weight of the chip and fruit is 4 lb., it is customary in the Cheddar Valley to consign 4 lb. net weight of fruit. The Growers' Association feel that they are meeting unfair competition from other districts, where the light-weight chip is used, and are considering giving a guarantee next season that each chip contains 4 lb. net weight of fruit when dispatched.

In this district, there is a very interesting practice, which might be very profitably extended, of lashing a strong stick or spar to the handles of four or more chips (Fig. 3). This gives much greater stability to the package, and packing in the vans is enormously facilitated, as a man can easily handle two sticks, totalling eight baskets, at once. When packed in this way, should it be necessary to top the fruit in the vans, it is much better protected, as other packages can be laid across the sticks, without actually coming in contact with the chips below.

The fruit is always covered in the chip, the covers used being of three types :—(*a*) Muslin (cost 7s. per gross); (*b*) Transparent grease-proof paper; (*c*) Thick non-transparent paper.

The muslin tops give by far the neatest appearance, and also give the buyer a chance of inspecting the fruit without removing the covers. The transparent grease-proof paper is the next in order of merit.

The effect of the method of packing is seen in the prices realised. One grower who invariably uses muslin, claims that he commands 2½d. to 3d. per lb. above the ordinary pack. A neatly packed transparent grease-proof paper will realise 1d. per lb. more than non-transparent paper.

The chips are manufactured locally and sold at 26s. per gross.

Handling and Delivery of Fruit.—The growers are most particular to ensure that the fruit arrives at the station in good condition. Fruit is very rarely topped on the growers' carts, but shelves are fitted to allow the fruit chips to travel in single layers

Markets and Market Charges.—Apart from Bristol the three principal markets favoured by the Cheddar Valley growers last year were Birmingham, Manchester and Liverpool.

Before the commencement of the season, many commission salesmen and their agents tour the district, and solicit fruit for sale on commission.

The Association Marketing Committee discusses any case of sharp practice on the part of commission salesmen, and any man not playing the game soon finds his supply cut off.

In addition to the carriage, most salesmen compel the grower to meet a charge of 1d. per chip for porterage. In addition the salesman usually takes 7½ per cent. commission on the sale price. In Birmingham market, it is customary to credit the grower 1d. per chip for the value of the chip, and this credit is occasionally allowed by salesmen in other markets.

Claims against the Railway Company.—It is interesting to note, that in spite of the tonnage carried up to June 25th last (223 tons 17 cwt.), claims have been received from growers for total loss of fruit to the extent of only a few cwt.

A CHIP BASKET FACTORY.

J. W. Lawry, Calstock.

It is generally agreed to be highly desirable that the countryside should be more fully developed, so as to provide remunerative employment for far greater numbers than at present. Nearly all the great factories are located in large towns and cities, and in many cases there are reasons why this is unavoidable, but in others the reasons are emphatically in favour of the industries being transferred to the rural districts. In the following paper an instance is given of such a transfer and the successive steps that led up to it.

For over fifty years the Tamar Valley has been known throughout the Kingdom as a great fruit growing district, especially for strawberries, of which it annually sends the earliest English supplies (grown in the open) to the various British markets. The writer sent the first consignment from Cornwall some 60 years since. Through improper packing this first venture was

a failure, but subsequently 1 lb. punnets were obtained from London. The fruit was ready for gathering some ten days earlier than from other out-of-door sources, and very high prices were obtained. From this small beginning the strawberry industry has continuously extended until the present output of the district is several hundred tons per annum. As this quantity is almost all put on the market in small packages an enormous number of packages is required.

At first, as above stated, punnets were obtained from London, but as the acreage of strawberries grew it was felt that an effort should be made to make them locally. Arrangements were first made with a Plymouth firm of timber merchants who installed special machinery for cutting the timber into shavings of suitable length and width. The shavings were tied into bundles and forwarded to the fruit growing district, where the women and children soon learned to weave them. The price paid for this work was 1s. per gross. The work was done in the workpeople's own cottages, and occupied them through the autumn and winter months. Later a further progressive step was taken, when steam planing machinery was installed in the district where the fruit was grown, and the business developed so successfully that besides supplying the local need, some thousands of gross were annually supplied to growers in Hampshire and Middlesex and even so far afield as Edinburgh. This continued until some ten years ago when another kind of package became popular and rapidly superseded the round punnet. This was the chip basket, a strong neat package containing 3-4 lb. (or for fruit other than strawberries 12 lb.) each. These baskets, which had metal handles and a cardboard, or chip, cover, did not require to be packed in cases as the punnets did, and were much preferred by the public. They were supplied in thousands from factories at Manchester and Glasgow, and consequently the punnet-making of the Tamar district ceased.

About the time when this happened the growers of the district formed themselves into a Fruit Growers' Co-operative Association, chiefly for the purpose of obtaining better prices for their fruit, especially that which had to be sold by the ton for jam.

They were materially aided in this by the officials of the Agricultural Organisation Society, who attended several meetings and explained the advantages of such co-operation. Some of the members of this Association were willing to increase the capital of the Association so as to establish a chip basket factory, but, as the outlay for providing the necessary plant would have been

heavy, a large number objected. There the matter stood, when in 1917 a large building within a hundred yards of the railway station, and adjoining the quays on the riverside, which hitherto had been occupied as a brick-making factory, was on the market for sale. Some of those who had previously desired a factory to provide their own baskets, saw that this offered a rare opportunity to carry out their wishes and took immediate steps to form a Limited Liability Association. The nominal capital of the Company is £4,000, with shares of £1 each, and 3,000 shares were subscribed chiefly by members of the Tamar Valley Fruit Growers' Association. The building referred to was acquired on favourable terms and contains an area of 5,000 sq. ft. under cover, and large yards available for the storage of timber in the open. Information was obtained through a similar chip factory, as to where the necessary plant could be obtained, and the engine and plant were installed by August, 1919.

Next came the work involved in procuring the right kind of timber (poplar, or similar soft wood), in planing it into suitable chips or shavings, and finally teaching girls to weave the baskets, wire stitch them, and prepare and fix handles and covers. All of this was satisfactorily performed after a few months' practice, until at present the quality of the baskets is such that applications for supplies are coming from distant places, such as Herefordshire and the Channel Islands, as the baskets are believed to be superior to those obtainable elsewhere.

The factory at present employs 8 men and 18 women and girls. During the first year's working over 400,000 packages were made and sold, and in 1921 over 500,000, the quantity of timber used annually being over 300 tons.

It is found that chip baskets are not only the best type of package for strawberries, but, also for other small fruits, such as raspberries, gooseberries, peaches, cherries and plums, except when for jam purposes. Dessert apples also realise a higher price when carefully packed in 12-lb. chips. The demand is increasing so fast that steps are in contemplation for increasing the accommodation so as to do a much larger business.

This short note would not be complete without reference to Mr. Richard H. Petherick, the energetic and capable Secretary of the Association, to whose foresight and enthusiasm the Association mainly owes its inception and success and also to its capable manager, Mr. J. Billing.

In conclusion it may be pointed out that there are many other fruit growing centres which are being supplied with baskets

made in distant cities which might follow the example described above, both to their own advantage and that of the rural workers.

The advantages to the growers are that they get their supplies at a lower price and without any cost of, or delays in, carriage, while they are also supplied with a better article.

The workers have the great advantage of living under the most healthy conditions, surrounded by green fields, and free from the smoke and grime of city life. The contrast between these workers on leaving the factory for their homes at the close of their day's work, and those returning from work in the cities is very noticeable—greatly to the advantage of the former, whose glow of health, vivacity and sprightliness are markedly different from the pale face, weary look and jaded gait of many city workers.

APPLE GROWING IN AUSTRALASIA AND AMERICA:

A Comparison with English Conditions.

C. R. WIMSHURST, B.Sc.Agric. (Lond.).

THE following considerations represent the result of personal inquiry into conditions of apple production in Western Australia, Victoria, Tasmania, New Zealand (North Island), British Columbia, Washington and Oregon, Ontario and New York State at the end of the late War. The inquiry was undertaken (1) owing to a sense of grievance at the comparatively poor prices obtained by really good home produce as compared with those realised by imported fruit, (2) out of curiosity as to how it was possible to produce cheaply such excellent fruit as that coming from Australasia, Canada and the U.S.A. with labour paid at the high rates obtaining in those countries, and (3) to ascertain what were the factors operating to prevent production of competitive material by the English grower.

The sense of grievance at poor prices obtained in competition soon gave place to one of admiration at the achievements of the Colonial apple grower in the face of formidable obstacles: the hacking out of a smiling orchard from the giant and gloomy gum forests of southern Tasmania surely requires the heart of a lion coupled with the patience of a Job, and one ceases to wonder at the achievement of such men in finding a market for their perishable produce half-way round the earth. The secret of their success has, of course, been loyal co-operation in marketing, but—and this is an important point—loyal co-operation

only obtained as a result of common adversity and appreciation of the unpleasant consequences of failure to co-operate. The failure of co-operative institutions among English fruit growers may be ascribed not so much to any inherent inability on their part to be loyal to each other in adversity, as to the fact that times have never been so bad that a grower could not find a market of some sort on his own initiative. The colonial grower produces fruit under conditions which mean the inevitable yearly glut of the local markets: the co-operative marketing association or the State Legislature, which controls the export organisation, can thus impose stringent regulations as to quality of produce exported and can command implicit obedience from the growers under threat of refusal of their produce, for which there is no local outlet. An Inspector of a Pacific Coast State who finds Codlin Moth infection in a single box of Extra Fancy grade dessert apples proceeding by rail for export, will condemn the whole carload—often 800 boxes. One can easily see therefore that growers of export fruit there, will take more than a leisurely interest in eradicating Codlin Moth from their plantations.

Cheap production by labour paid at high rates has been made possible in fruit-growing by the adoption of those principles of factory production that have brought such success to other industries—namely, high production of a limited variety by a minimum of labour.

Australia has concentrated on the small open-centred "Bush" type of tree grown on Northern Spy stock, which confers freedom from Woolly Aphis (*Schizoneura lanigera*) on the root system. In Western Australia it is reckoned that a man and his wife, with the help of two casual labourers at harvest time at 12s. 6d. per day each (1920), can do all the work of cultivating, pruning, thinning and spraying 12 acres of orchard planted with these small trees at 20 feet square and growing to a maximum height of 11 feet. This area represents an average of 3,600 boxes of exportable fruit per annum on the best managed plantations. All fruit can be gathered from the ground or a very small step-ladder, and intercropping is out of the question owing to the necessity for continual summer cultivation to tide over the rainless period. The export varieties of Western Australia are four only—Cleopatra, Jonathan, Five Crown, and Munro, with Yates as a probability in future: all these are keeping dessert varieties. Western Australia, while starting late, has been able to profit by the mistakes made by other States, so that her apple industry may now be looked upon as the most up-to-date on the continent.

On the Pacific Coast, where labour rates are higher—4 to 6 dollars per day being paid at harvest time in 1920—specialisation and production have to go still further, and 300 boxes per acre is not considered sufficient. Growers have there developed a bigger type of tree kept as near the ground as possible. An orchard of irrigated trees planted 30 feet square on vigorous seedling stocks, with about 2 feet of trunk and growing to a maximum height of 14-15 feet, will not uncommonly be made to produce 800 boxes of export fruit per acre at 15 years old. Once the tree is well shaped with a "modified leader" filling up the centre of the tree very little pruning other than a yearly thinning out is found necessary, a contrast to the continual and thorough spur-pruning necessary on the small Australian trees.

Ability to gather the fruit from a step-ladder is an essential factor in orchards producing export fruit: the lean-to ladder is as obsolete in such orchards as the hand-hoe. It is perhaps in their methods of handling the fruit at harvest time that the Pacific Coast States particularly excel. The grower merely picks his crop into boxes and takes these down unclosed on a motor truck to his fruit company or co-operative association; he unloads each box down a sliding chute which conveys it to a large storage basement; here each grower's crop is stacked separately until conveyed by machinery to the top of the building for machine grading and packing. To bridge a distance of even 50 feet between the end of a receiving chute and two men stacking in a corner of the basement, it has been found worth while to use small portable conveyors on roller bearings at a dollar per foot! Where labour at 6 dollars per day is to be saved, capital expended on mechanical aids to labour is never grudged. After it has been graded and packed the fruit is "shipped" in car loads of any one grade and variety in refrigerator freight-cars holding up to 800 bushel boxes each. Packed according to the State grading specifications and subject to examination at any time by the State inspectors, a bushel box of Extra Fancy Newtowns means something very definite to a buyer in any country and thereby earns a premium which an individual English grower can hardly hope to command even if he can grow identical material.

Can he, however, grow identical material? The writer is rather sceptical on this point. Okanagan Valley, Wenatchee, in Washington State, U.S.A., and the Huon Valley of Tasmania have the climate *par excellence* for box apple production. It would appear to be a fact that all boxed apples exported to

England come from localities that can mature a "cob" of maize in the open during the summer. The climate of S.E. and E. England, the driest that we can manage, is not warm enough to do this, and is far moister than is good for box apple country. S.E. England approximates in climate to the coastal belt of British Columbia, Washington and Oregon, which is what they would call over there "berry country," more suitable for raspberries, blackberries, gooseberries, etc., than for hard fruit. Even this coastal belt, however, will mature a "cob" of maize in the open during the summer: it will grow apples and pears readily enough, but its moist atmosphere makes the operations necessary to eradicate black spot (*Venturia inaequalis*) and other fungoid diseases too costly and uncertain, in comparison with those sufficing in "God's own country" over the coastal range, with its bright dry atmosphere. Spain and Portugal, Northern Italy, and Southern Russia have more the climate for box-apple production than S.E. England. Wenatchee (Washington, U.S.A.) was growing sage-bush and other desert vegetation before an irrigated system made apple growing possible. Indeed, certain strains of the apple would appear to have originated on the fringe of the deserts of Central Asia so that to find it flourishing under arid conditions is perhaps not so surprising as might at first appear. Near Perth in Western Australia or Auckland in New Zealand, flourishing apple orchards producing quality in quantity are found next door to plantations of lemons and other citrus fruits.

In their endeavour to produce clear unblemished fruit of export quality, the most favoured English districts are under the following disabilities:—

1. They have no highly-coloured keeping dessert apples of strong cropping powers at their command. Worcester Pearmain possesses many desirable qualities but will not keep very long. Cox's Orange Pippin is weak in constitution and particular as to locality. Blenheim Orange is a fine vigorous grower but too shy a cropper on young trees. Gascoigne's Scarlet and Baumann's Winter Reinette show no great evidence of coming popularity. The English growers seek as yet in vain for the equivalent of Jonathan, King David, Yates, Arkansas Black, Esoper Spitzenberg, Ben Davis, and Stayman Winesap. Attractive colour without draws the public quite as much as superior flavour within.

2. They do not obtain sufficient sun and dry air in summer (1921 being an exception and the chance of a lifetime for the

home grower to put up a good show) necessary to produce a highly-coloured fruit of long-keeping qualities. The thick skin of imported apples, though disparaged in many quarters, is nevertheless a commercial asset of no small value when one considers the long-keeping and good travelling qualities thereby conferred on the fruit. The moist atmosphere of our summer climate encourages black spot, brown rot, canker and apple mildew to an extent not met with in continental climates with bright, dry summer air. These fungi can doubtless be kept under in England, but at an outlay considerably greater than that needed in dry regions.

3. It appears to be impossible in the presence of alternative markets to get co-operative marketing associations started in England with sufficient power to command the obedience of their members under threat of refusal of their produce if it does not conform to certain standards. Marketing thus resolves itself into the efforts of the individual grower to achieve a reputation for his produce in competition with the strongly established reputation of imported brands zealously guarded by efficient State inspection.

4. Despite the valiant efforts of the small body of research workers dealing with problems relating to English fruit, much definite knowledge is still required by the home grower to enable him to produce a major percentage of his crop of the high quality of produce that comes in such huge quantities from exporting countries.

In the face of such disabilities it is perhaps hardly surprising to find that the majority show a preference for the Bramley, Newton Wonder, Lord Derby, etc.—strong-growing, heavy-cropping cookers that revel in a moist atmosphere and are easily kept free from black spot. For a Kentish orchard, Bramley, Lord Derby, Lane's Prince Albert, and Newton Wonder might be described as the grower's stand-by, that make it possible to experiment with box fruit such as Beauty of Bath, Worcester, Lady Sudely, James Grieve, Cox's Orange Pippin and Blenheim Orange.

With the help of a thorough spring lime-washing most people can grow huge crops of " rank old cookers " every other year, if not yearly in the case of Lane's Prince Albert; but the growing of box fruit must still be looked upon as the task of a highly skilled specialist with considerable capital behind him to enable him (1) to build up an individual reputation for the packing and quality of his produce, and (2) to supplement present limited

knowledge by continual experiment, more especially in spraying, thinning, and the overcoming of biennial cropping.

In recent times of scarcity the grower of quantities of cooking apples undoubtedly scored, but the future prospect of fierce competition from so many countries surely seems to warrant increasing attention to high quality keeping dessert apples—apples which need never fear a glut.

CULTIVATION OF THE HOP CROP.

II.—MANURING.

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THE hop crop involves so many other costly operations that it is of fundamental importance to manure adequately so that a full crop may be realised; the novice will, therefore, require plenty of pluck to buy and use a sufficiency. By this it must not be assumed that manuring cannot be carried to excess, indeed this is often done with disastrous results as regards ripening, and disease; nevertheless manuring must be very heavy.

The first point to study is the soil upon which the hops are to be grown: its physical properties must be carefully studied by observation; the depth of soil and the character of the subsoil must be examined with a view to deciding the extent of the feeding area of the hop roots both for plant food and especially for water—there is little point in manuring a crop heavily when the water supply will limit the crop; finally the chemical characters of the soil—those which determine the supply of plant food—must be known: these may be ascertained chemically, provided the interpretation of the analysis is put in the hands of someone who understands both soil analyses and something about hop-growing—or ascertained by the results of manurial experience upon similar soil, or by direct experiment on the field. The items of plant food in the soil which chiefly interest the hop-grower are the same for all other crops as:—lime, organic matter, nitrogen, phosphates, potash.

The *lime* content of the soil is a matter capable of quick and easy determination by the chemist, and since it is a matter of great importance should always, except when the soil is definitely known to be calcareous or chalky, be chemically determined. The advantages of an abundant supply of free lime in the soil are many and varied; in the first place it is very beneficial to

the texture of all soils on the heavy side; secondly, it keeps the soil "sweet" by neutralising any acids present in the soil or added to the soil by chemical manures; thirdly, it is most beneficial to the growth of the numerous soil organisms which are concerned with the decomposition of the humus in the soil, so that its constituents may become available for plant growth. Any deficiency in lime should be made good from the outset by the application of one of the forms of lime available—ground-lime, quicklime, or chalk—according to the usual factors governing the use of lime (*See* Leaflet No. 170), and, when necessary, this soil constituent should be periodically replenished, since it is liable to rapid loss from the hop garden.

The *organic matter* is perhaps for the hop-grower the most important ingredient of the soil. Successful hop-growing depends upon keeping this at a high level for many reasons: firstly, as with lime, the organic matter plays a very important part in maintaining a good texture in the soil; this is most important because in hop-growing it frequently happens that injury is done to the texture by operations, such as washing, having perforce to be carried out when the soil is too wet; a soil containing a good supply of organic matter allows a good state of texture to be recovered more quickly. Secondly, a good supply of organic matter, both by helping the texture and by reason of its own properties, enables the soil to hold and retain large supplies of moisture for the hop roots. Lastly, all organic manure has been formed directly or indirectly from plant life and therefore contains within itself all elements of plant food; these are not necessarily present in the best proportion, nor are they immediately available for the hop roots, but in the soil this organic matter is continually undergoing change by which the plant food it contains is gradually and continuously made available for plant roots. The rate of these changes is not constant, but varies according to a number of factors, of which moisture, temperature and supply of air are the most important, and since the last factor, that of air supply, is controlled by tillage, the hop grower is enabled to control to some extent the rate at which the plant food stored in the organic material becomes available. The amount of organic matter present in most soils, except recently broken old pasture, requires to be considerably augmented before it reaches the standard of fertility considered desirable for hop-growing.

Nitrogen.—Practically all the nitrogen held in soils is combined within the organic material; a soil which is well supplied with organic material will as a general rule contain relatively large quantities of nitrogen. It has previously been stated that this organic matter is constantly—though not always at the same rate—undergoing change resulting in the production of plant food. The most important resultants of these changes are the nitrates, which are the forms in which plants absorb nitrogen as a food. Now it is important to realise that nitrogenous plant food has a specific effect upon plant growth; it stimulates the growth of foliage stem and leaf. If nitrogenous plant food is deficient the bine is yellowish and stunted in growth, the crop will be small; if nitrogen is abundant then growth of foliage will be luxuriant and may result (provided other conditions are favourable) in a full crop. It is, however, possible that the supply of nitrogenous plant food, especially in a wet season, may be excessive. In this case foliage is too luxuriant and abundant, the lateral branches become matted together so that the supply of light and air are insufficient for the formation of "burr" and the growth

of the hops, while the development of the hop mould is encouraged and the difficulties of killing all the aphis are greatly increased.

It can easily be realised, therefore, that it is essential to adjust the supply of nitrogenous plant food during the growing period; a fair supply during the early season so as to produce a vigorous yet hardy and short-jointed growth to furnish the strings; an abundant supply during mid-season so that the bine may form plenty of burr and so that this may "roll" out into fine large hops; but a restricted supply when the hops are ripening so that they may develop a good primrose colour.

Phosphates are another important ingredient in all soils, and probably no soil contains a sufficiency for the intensive production of any crop. The influence of phosphates upon plant growth is not so well-defined as that of nitrogen, none the less it is known to be intimately associated with certain processes in the plant: thus it plays an important part in root development and is of great importance in the formation and ripening of flowers and seeds and consequently of the hop cones; it will be noted that these important influences are not so easily observable as the effect of nitrogen, which produces a vivid dark green colour and rapid growth, and consequently the effect of ample phosphatic manuring may be valued too lowly unless the test of weighing the crop is applied; when this is done, however, its value is generally made apparent.

Potash is generally plentiful in clay soils and deficient in light soils; on the clays little if any potash requires to be supplied beyond that contained in the frequent dressings of dung, but on light soils it is necessary to include some artificial potash in the manurial scheme.

Practice in Manuring.—Previous to planting and during the first few years in the life of a hop garden, manuring should be exceptionally heavy so as to bring the garden rapidly to a high state of fertility; this of course is especially true in the case of any element of plant food in which the soil is known to be deficient. It will perhaps be convenient to examine the manuring in the same order in which the plant food has been considered:—

Lime.—Any deficiency of lime, indicated by sourness of soil or bad textural conditions, should be remedied at once by a heavy application and the lime-content should be maintained in any garden in which this is small by repeated applications of ½ to 1 ton of quick or ground lime every fourth year; or by the application of 8 or 10 loads of chalk once in ten years.

Organic Manure.—By far the best means of increasing this constituent of the soil is by the use of farmyard manure—unfortunately it is rarely the case that sufficient can be obtained, in which case horse manure from the towns is the best substitute, and, failing this, shoddy* may be and is used in large quantities by hop-growers; where shoddy is used, it is important to realise

* *See* Leaflet No. 175.

that, unlike dung, shoddy contains no potash or phosphates and consequently applications of these must be increased.

In normal practice 20 to 30 loads of dung per acre should be applied each year during the early life of a hop-garden, or as a substitute 2 to 3 tons of shoddy. The usual time at which the dung or shoddy should be applied is during autumn or winter, to be ploughed and worked into the land, yet dung may be advantageously applied in summer provided it is properly treated —preferably it should be spread along close to the hop-hills and either ploughed under cover or covered up with soil by forks so as to prevent loss of ammonia into the air. This latter practice, "summer-dunging," is economical from another aspect; it is well recognised that dung, no matter how well it may be stored, constantly loses nitrogen. Russell* and Richards have shown that these losses may be as much as 30 per cent. during three months' storage; such loss of nitrogen falls almost exclusively on the most soluble and therefore most valuable constituents of the dung; if, therefore, the dung made during the latter part of winter is judiciously applied to the hops, this soluble and available nitrogen is converted to good use by the hop roots, and the less soluble constituents, the decaying straw, etc., are no less valuable to the soil for textural and other purposes by this method of application. It is to be remembered, however, that there is a right and a wrong time to apply dung in summer; it will do little or no good if application is delayed till August, but will give best results if it is applied so that it is available for the hop roots just before "burr" begins to be formed.

Quick-acting Nitrogenous Manure.—We have already seen that in order to obtain best results the hop plant requires to be supplied with a continuous and ample supply of nitrogenous food from the time when growth begins in the spring until the formation of the "burr" is complete. We have further seen that the application of organic manures such as dung and shoddy as well as the organic matter already present in the soil leads to a continuous, though irregular, supply of available nitrogen; this supply following the dead winter season is likely to be ample for the needs of the hop during the early stages of growth, but may not be sufficient to produce the vigorous growth required whilst the "burr" is being formed. It is, therefore, generally necessary to supplement the slowly available dung and soil nitrogen with some quick-acting nitrogenous fertilizer.

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* *See* Leaflet No. 93.

One other reason may render the use of quick-acting nitrogenous manure advisable, namely, if the growth of the plant receives a check caused by severe aphis attack or a spell of cold east wind; quickly available nitrogenous manure is the most certain way of bringing the plant again into active growth.

The choice in the use of quick-acting nitrogenous manures is wide, ranging from immediately available nitrates (nitrate of soda or nitrate of lime) through such manures as sulphate of ammonia or calcium cyanamide to guanos of various kinds, organic in origin, more or less quick in action and containing larger or smaller quantities of phosphates. If the case is one in which an immediate stimulus is required, as for instance when a garden is short of bine or an attack of aphis has checked growth, then one of the nitrates should be used; if the garden is well-supplied with lime and sulphate of ammonia is cheap per unit of nitrogen then this should be used in preference to the nitrates; if the maximum effect is not required for two or three weeks, then preference may perhaps be given to meat meal or other guano because its action may be expected to be more prolonged. In general it is desirable to avoid the use of heavy dressings of nitrates late in the season to Golding hops on good quality land because this causes the cones to be coarse, especially as to the sterile bracts, but these manures may be advantageously used for Fuggle hops.

In any case such artificial nitrogenous manures should be well worked into the soil, so that they may be incorporated with the moist soil in which the roots are growing; in general the manures should be distributed evenly over the full width of the alley, but during the first two seasons before the hop roots have spread throughout the soil, better results will be obtained by spreading the manure within a few feet of the hop plants.

Phosphates.—Phosphatic manures after application are stored in the soil without risk of loss by washing, and remain available for the use of plant roots; practice in the application of these is very different from that of nitrogenous artificials. Phosphatic manures should generally be applied in excess of crop requirements during the winter or early spring season so that they may be incorporated and intimately mixed with the soil by spring cultivations. The actual choice of phosphate manure will depend upon the nature of the soil and especially upon the lime-content of the soil. If the lime-content is good then superphosphate or dissolved bone manures will generally produce bests results; if

the lime-content is poor then organic phosphates, such as those contained in the guanos, bone meal or steamed bone flour will be preferable. If the land is a heavy clay then a high-grade basic slag (low-grade slags are generally very insoluble) may be chosen, or soft-grinding mineral phosphates may be substituted.

Potash.—Potash manures like the phosphates should be applied during early spring and worked well into the land; when well-made farmyard dung is freely applied little or no potash manures are required on heavy land; but when shoddy displaces dung or the hop-garden is on light soil then potash manures must be used. There is little evidence to show which of the potash fertilizers gives best results and when small quantities only are being used the choice should rest with whichever potash salt is cheapest to apply per unit of potash. If the dressings of potash to be applied are large then the impurities in kainit may possibly act deleteriously and in that case preference should be given to either muriate or sulphate of potash.

Special Hop Manures.—A hop-grower who has a reasonable knowledge of the functions and uses of artificial manures has no need to buy special hop manures, which will always be more costly than the pure manures, no matter how glowingly the analyses of such special manures are set forth. On the other hand, when a grower desires to apply a composite mixture of manures, the help of the manure merchant may be profitably accepted, both for information as to what manures can be advantageously mixed, and for the actual mixing of them. Usually, however, mixtures do not result in much economy, as the quantities used in hop gardens are large and can therefore be accurately distributed alone.

Schemes of Manuring.—A few typical cases of manuring are appended to illustrate the standard commonly adopted by successful hop-growers.

Scheme I.—For newly-planted hops on a brick-earth loam well supplied with lime.

30 to 40 loads of good farmyard dung, ploughed into land in autumn before planting.

10 cwt. superphosphate, broadcasted in March.

5–10 cwt. fish guano or meat meal, distributed round the hills in April and carefully forked in.

Scheme II.—For newly-planted hops on stiff clay soil, deficient in lime.

30 to 40 loads of good dung, ploughed into land in autumn before planting.

1 ton ground or quick lime and 10–20 cwt. high-grade basic slag } distributed on top of the ploughing as early as possible.

5 cwt. fish meal, or 3 cwt. nitrate of lime } distributed round hills in April and carefully forked in.

Scheme III.—For one-year old hops (half pole), which should yield ½ to ¾ of a full crop, on a loam soil, well supplied with lime.

3 to 4 tons of shoddy, ploughed into land in winter.

10 cwt. superphosphate and 2 cwt. sulphate or muriate of potash } broadcasted in March.

10 cwt. meat meal, etc., spread along slips and forked into ground in April.

2 cwt. sulphate of ammonia or nitrate of soda, broadcasted in May.

N.B.—When shoddy is used instead of dung some potash and phosphatic manure must be added if the dung is to be completely substituted: approximately 2 cwt. of sulphate of potash and 4 cwt. of superphosphate (30 per cent.) will contain the equivalent potash and phosphoric acid in 10 tons of dung (= 15 to 20 loads).

Scheme IV.—Full-grown hops on loam, well supplied with lime.

20 loads of good dung, ploughed into land in winter.

8 cwt. superphosphate, broadcasted in March.

5-10 cwt. nitrogenous organic manure (*i.e.*, fish meal), broadcasted in April.

and 1 to 2 cwt. sulphate of ammonia or nitrate of soda in May or June if hops get checked or are short of bine.

Scheme V.—Full-grown Fuggles on clay, deficient in lime.

20 loads of dung, ploughed into land in autumn.

10 cwt. high-grade basic slag, broadcasted in autumn or winter.

5 cwt. nitrogenous organic manure, broadcasted in April.

2 cwt. sulphate of ammonia or nitrate of soda, broadcasted in May.

1 cwt. nitrate of lime or nitrate of soda, broadcasted in June, and in addition to this 1 ton of lime every 4 or 5 years.

CUMBERLAND PIGS.

SANDERS SPENCER.

ANOTHER breed of pigs which has been named after the county in which it has been largely bred for a great number of years is the Cumberland breed.* It is essentially a local production and its long-continued existence has been solely due to the fact that it completely supplies the wants of the Cumberland farmers in that it is hardy, prolific, thrives well on the somewhat exposed farms, makes the best possible use of the large quantity of dairy offals available, fattens readily, and when slaughtered

*An article on "Berkshire Pigs" appeared in this *Journal* for January last, p. 887.

FIG. 1.—A Cumberland Sow.

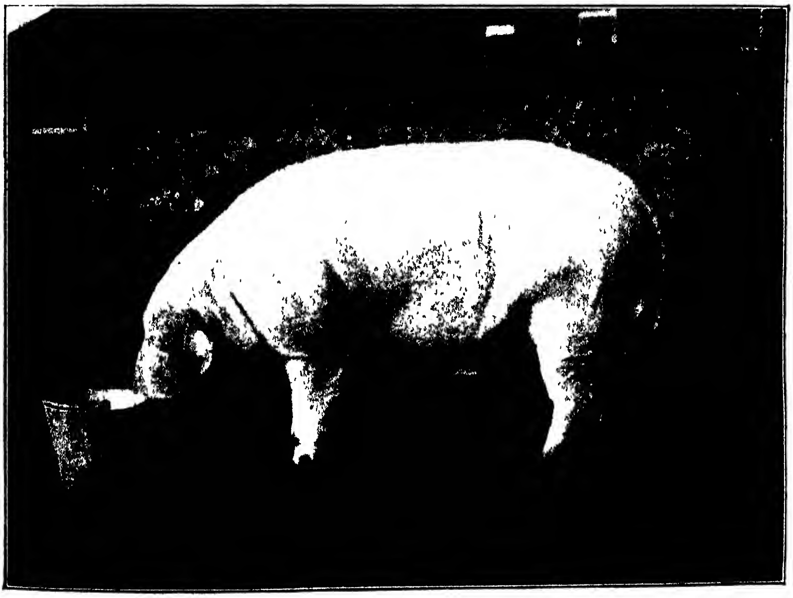

FIG. 2.—A Cumberland Boar.

furnishes a carcass of pork of fine quality, which on being converted into bacon is greatly in demand on those markets where quality of bacon and hams is highly esteemed, and command the highest prices current.

Of its origin very little appears to be known. It possesses several of the points of the pig common in Denmark, which goes by the name of the Land Race. In form and character it is very similar in two points, the form of the head and its length, as the head of the Cumberland pig is rather short, with an upturned snout, but in the hair it is very dissimilar, this being very fine and limited in quantity. It is generally considered that shortness of head, heaviness of jowl and sparseness of hair are indicative of excess of fat in proportion to the lean meat in most breeds of pigs, but this does not appear to be the case with the Cumberland pig, or the bacon and hams manufactured from it would not have attained and held for so many years a position amongst the highest in the provision trade. It may be possible that the production of a large proportion of lean meat and the firmness of texture of the fat portion of the carcass have become a part of the Cumberland pig's nature owing to the conditions under which it exists, *i.e.*, it has lived for many generations a hardy and open-air life, and has been largely fed on dairy offals, especially during the fattening stage. Evidence that the quality of the meat furnished by an animal is greatly affected by the life which the animal has led, is furnished by the following extract from the published report of an interview with the meat buyer for two of the principal restaurants in London :—

> "We serve a fillet of beef that is unrivalled in Europe. It is raised by a French agriculturist from bullocks that are not only fed with exceptional care, but also worked at plough. This exercise, carefully watched and regulated, gives to the flesh an extraordinarily even admixture of fat and lean, and produces a steak like no other."

The claim that acquired characteristics, whether from the system of feeding or from the conditions long continued under which the animal has lived, eventually become permanent may be said to receive support from the Cumberland pig in its present state.

In the introduction to the first volume of the herd book of the Cumberland Pig Breeders' Association extracts are given from books and treatises published in the early part of the last century. These clearly prove that the Cumberland pig of that day possessed some of the peculiar characteristics of the present-day pig, such as the rather large hanging down ear, and the smooth white skin with occasional blue spots which are not as

frequently apparent at the birth of the pig as later in life. It is thought by some persons that the Cumberland pig of olden times was a larger and somewhat coarser type of pig than that common at the present day. This refining and improvement may have been due to a certain extent to the admixture of the blood of the class of pig bred in Lancashire and North Yorkshire, and now known as the Middle White. That well-known old Yorkshire pig breeder, Mr. Mangles, informed the writer many years ago that he had sold many of the finer quality short-headed Yorkshire boars for use in Cumberland. The use of these boars may have had some influence on the size and quality of the old-fashioned Cumberland pig, but it is probable that most of the improvement in its character has been brought about by the continued care of the Cumberland farmer in the selection for breeding purposes of only those boars and sows of the form and quality necessary in the manufacture of the choicest bacon and hams for which the county has been noted for so long a time.

That the farmers and pig breeders in Cumberland are still animated by the desire to continue their efforts to place their cured meats in the highest position on the markets appears to be proved by the movement which has been inaugurated, having for its object the labelling of all Cumberland hams and bacon manufactured from pigs bred and fattened within the county, and naturally more or less of the type, form and character of the Cumberland pig, so that they are easily distinguished from hams and bacon produced from fat pigs of other breeds which have been sent into the county and there cured in order to secure that higher price on the market which is said to belong of right to the real Cumberland hams and bacon.

The standard of excellence issued by the Cumberland Pig Breeders' Association is as follows:—

Head.—Fairly short, wide snout, dished face, wide between ears.
Jowl.—Heavy.
Ears.—Falling forward over face, long and thin.
Neck.—Fairly long and muscular.
Chest.—Deep and wide.
Shoulders.—Deep and sloping in to the back, blades not prominent but in line with ribs, not too wide on top.
Back.—Long and level or with slight arch from head to tail.
Ribs.—Deep and well sprung.
Loins.—Broad and strong.
Sides.—Deep.
Belly and Flank.—Full and thick.
Quarters.—Long and level or with only very slight droop.
Tail.—Set high, not coarse.

Hams.—Very large and well filled to hocks.
Legs.—Short, straight and strong.
Colour.—White.
Skin and Coat.—Smooth, hair straight, fine and silky, and not too much of it.
Size.—Large without coarseness.
Disqualifications.—Black spots, black hair, prick ears.
Objections.—Blue spots.

POTATO LEAF CURL DEMONSTRATIONS.

A. D. COTTON.

Mycologist to the Ministry of Agriculture.

IT is well known (1) that potatoes affected with the disease termed Leaf Curl or Leaf Roll suffer a very severe reduction in yield, and (2) that it is by the use of infected seed that infected crops with poor yields are produced. The necessity, therefore, of using really good seed is clear. A large amount of very careful research on potato diseases of this type has been carried out during recent years, both in Europe and America, and the results all emphasise (*a*) the necessity of preserving from infection plants grown for seed-purposes, and (*b*) the immense importance to growers of planting only absolutely healthy tubers.

With the commendable object of saving expenses, growers are often tempted to use home-grown seed instead of purchasing a fresh supply from a good seed-area. If the crop is free from disease, and especially from such troubles as Leaf Curl and Mosaic,* this course cannot be objected to, but if the two diseases mentioned are present, even in mild form, the resulting crop will develop the same trouble, and the small weight of tubers should show it to be false economy. Farmers are usually more fully aware of the importance of good seed than the owners of smaller holdings. The latter are only too ready to blame the soil or the weather for a poor yield, whereas it is commonly due to the use of infected seed. A walk round allotments in any county of England will show that the "good seed" lesson has not yet been learned.

With a view to providing a practical demonstration of the effect of Leaf Curl on the crop and the value of healthy seed the Ministry instituted trials in various centres in 1921. In order

* An account of these two diseases will be found in the Sectional Volume, No. 3 (*Cultivation and Diseases of Potatoes*), price 8d., post free.

to minimise as much as possible the effect of local conditions and to render the demonstration of the widest service, the trials were located at the twelve advisory Colleges or Institutes situated in the twelve provinces into which the country is, for agricultural educational purposes, divided.

The variety selected for experiment was Arran Comrade, the seed being grown in the neighbourhood of Edinburgh, 1 cwt. of healthy seed and 1 cwt. of seed affected with Leaf Curl were sent to each College. The healthy seed was obtained from a field carefully examined and found to be entirely free from disease. The second lot of seed was from a field a few miles distant which was generally, though slightly, affected with Leaf Curl. The land here was, if anything, slightly more moist than where the healthy seed was grown. The attack on this field was so slight that some growers would probably have regarded the crop as healthy, and even by those conversant with Leaf Curl it might have been regarded as sufficiently good for seed-purposes. The following figures supplied by the Institutes show how much the yield is reduced when seed affected with Leaf Curl is used :—

Aberystwyth, University College of Wales.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	3 cwt. 13 lb.	8 cwt. 4 lb.	43·7
No. of plants ...	463	522	

Long Ashton, Research Station, Bristol University.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	4 cwt. 3 qr. 2 lb..	13 cwt. 6 lb.	36·5

The "take" very uniform in both plots ; Leaf Curl plot remained very stunted. No allowance for "misses" was necessary.

Reading, University College.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	2 cwt. 7 lb.	8 cwt. 1 qr. 14 lb.	49·6
No. of plants	637	637	

Plot with healthy plants ploughed two months before planting and subsequently cultivated. Plot with Leaf Curl plants not well cultivated ; cabbage stumps left until dug just before planting. 25 per cent. added to third column to allow for this disadvantage.

Newton Abbot, Seale Hayne Agricultural College, Devon.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	1 cwt. 2 qr. 26 lb.	5 cwt. 2 qr.	51·5

A number of misses occurred in Leaf Curl plot, and therefore an allowance of 20 per cent. has been added to third column. With a very few exceptions the curled plants produced only one potato of ware size and three or four small tubers ; healthy plants produced, on an average, four of ware size.

Wye, South Eastern Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	3 cwt. 2 qr. 8 lb.	7 cwt. 2 qr. 26 lb.	46·1
No. of plants	645	645	

Cambridge, School of Agriculture.

Failure through drought.

Manchester, Victoria University.

Trials postponed.

At the following Institutes the results are estimated at yield per acre :—

Bangor, University College of North Wales.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	6 T. 16 cwt. 2 qr. 9 lb.	14 T. 8 cwt. 3 qr. 21 lb.	47·3

On May 20 healthy plants well above ground, curled plants only just showing; this difference in rate of growth was apparent throughout the growing season. Only two or three tubers failed to produce plants.

Newport, Salop, Harper-Adams Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	6 T. 10 cwt. 3 qr. 8 lb.	8 T. 12 cwt. 2 qr. 18 lb.	75·7*

Leeds University, Garforth Farm.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	6 T. 13 cwt. 1 qr.	11 T. 1 cwt. 1 qr.	60·2

Very few misses.

Sutton Bonnington, Midland Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	2 T. 10 cwt. 1 qr. 3 lb.	5 T. 4 cwt. 2 qr. 16 lb.	48·1

Newcastle, Armstrong College, Cockle Park Farm.

	Curled.	*Healthy.*	*Diseased Yield. (Healthy=100.)*
Weight ...	4 T. 11 cwt.	10 T. 14 cwt.	42·1

It will be seen from the results that seed which was infected with Leaf Curl yielded, with the exception of two cases, only about one-half that given by the healthy seed, and this, it may be repeated, was from seed derived from plants which were only mildly attacked the previous season. The full figures with regard to the proportions of ware, seed and chats in each crop are not published in full on account of space, but are available for those who are interested in the subject.

It is clear from the facts given that the planting of good seed is one of the most vital factors in successful potato growing. In these lean times no grower should be careless as to this matter, and no one can afford to take risks and secure only half a crop.

* When the figures for Harper-Adams College are compared with other centres, especially Bangor and Leeds, it would appear that the healthy seed at this centre must have suffered in some way and not produced its normal crop.

THE FOOD AND FEEDING HABITS OF THE LITTLE OWL.

WALTER E. COLLINGE, D.Sc., F.L.S., M.B.O.U.
Keeper of the Yorkshire Museum, York.

FOR some years past there has been a growing opinion that the Little Owl (*Carine noctua*, Scop.) is an injurious bird against which strong repressive measures should be taken before more serious damage is occasioned.

Be this as it may, it is obvious that without a more exact knowledge of its food habits, it would be unwise to proceed to destroy a bird merely upon hearsay or because of isolated and local causes of injury.

In order, therefore, that there may be some solid ground upon which to act, an investigation was commenced in 1918 with the object of obtaining specimens of this bird from numerous districts in Great Britain, throughout the different months of the year, and over two or more successive years, and to estimate the food by the volumetric system; further, to study the nature of the food fed to the nestlings and eaten by the parent birds during the nesting season, and to inquire if there was any variation in the nature of the food in different districts and seasons.

The Introduction and Spread of the Little Owl.—Most of the recorded occurrences of this species before 1843, as an occasional immigrant to the British Isles, are open to doubt. They have already been dealt with by Coward (7)* so I need not repeat them here.

In 1842 Waterton made an attempt to establish this bird in Yorkshire. In his *Essays of Natural History* he recounts how he saw them in the market place at Pantheon, Italy. He says that the bird "is much prized by the gardeners of Italy for its uncommon ability in destroying insects, snails, slugs, reptiles, and mice. There is scarcely an outhouse in the gardens and vineyards of that country which is not tenanted by" this species. Thinking that it "would be peculiarly useful to the British horticulturist" he determined to import some of these birds, and after losing six specimens on the voyage and another soon after landing, he successfully introduced five birds. "On the 10th of May, 1842, there being an abundance of slugs, snails, and beetles on the ground, I released them from their

* These figures within brackets indicate references to literature to be given in the concluding part of the article.

long confinement. . . . At seven o'clock in the evening, the weather being serene and warm, I opened the door of the cage. The five owls stepped out to try their fortune in this wicked world."

While we have no proof that these specimens actually established a colony, there is every likelihood that the birds wandered away and nested.

The late Lord Lilford (15) at various times previous to 1889 liberated specimens at Lilford, near Oundle, Northamptonshire, and Mr. E. G. B. Meade-Waldo introduced specimens at Stonewall Park near Edenbridge, Kent, about 1874. Both of these introductions were successful. Finally, about 1890, and again in 1905, Mr. W. H. St. Quintin turned out some specimens at Scampston Hall, Rillington, Yorkshire, "but they did not do well, and have now apparently disappeared" (15), as also specimens released at Tring by Lord Rothschild.

From these various centres the Little Owl has spread all over the country, having been recorded from no fewer than 36 English counties, 6 Welsh, 2 Scotch, and 1 Irish.

This bird has undoubtedly proved a most successful colonist, for it has not only spread itself over the whole of the country, but it has increased in a remarkable manner.

Field Investigations.—In an investigation of this kind it is very important that the evidence from all quarters should be carefully considered before arriving at any conclusions. In this connection, therefore, observations made in the field are very desirable. It is important, however, that such observations, if they are to be of any value, should be made by those who know the Little Owl and are not liable to confuse it with other species, which is not infrequently the case.

Abundance.—There is now considerable evidence to show that the Little Owl is fairly abundant in most parts of England, and that it is slowly spreading to Wales and further north into Scotland. It is said to be "By far the commonest owl in Bedfordshire"* as many as 20 being seen together in small spinneys, and is recorded as "very common" in Hertford, "Fairly common and plentiful" in Leicester, Northampton, Kent, Devon, Dorset, Somerset and Wilts., "Becoming numerous" in Lincolnshire, Yorkshire and Herts., "Have greatly increased since 1914" in Sussex and Essex. A correspondent writes from Suffolk that during 1920 there were twice as many as in 1919. Another states that on one estate in

* Atchison, G .T., Brit. Birds, 1912, p. 66.

Leicestershire 30 specimens were shot in 1919, while on an Essex estate 24 young birds were hatched in 1920.

Rate of Increase.—Reliable information as to the rate of increase of the Little Owl in different districts has proved somewhat difficult to obtain. Many of the statements are obviously only surmises and not based on actual observation. In a few instances, however, the actual nests have been counted. Many correspondents remark that the full brood of 4, 5, or 6 are all reared, and that the young birds are peculiarly alert.

Assuming then that a pair of birds annually produce four young, half of each sex, and that all live, together with their offspring, in six years the progeny of a single pair would be 1,458 (cf. Table).

TABLE 1.—Showing the annual increase and total number of Little Owls, the progeny of a single pair, in successive seasons for six years, assuming that all lived.

Years.	*Number of pairs breeding.*	*Number of pairs of young.*	*Total number of pairs.*	*Total number of birds.*
1st	1	2	3	6
2nd	3	6	9	18
3rd	9	18	27	54
4th	27	54	81	162
5th	81	162	243	486
6th	243	486	729	1458

On a rough computation of this kind, it is clearly evident that we must have in this country at the present time quite a large number of individuals. Supposing, however, that we put the number in the sixth year at a sixth of 1,458,, *i.e.*, 243, and assume that in 30 English counties there are in each 10 pairs of birds to begin with, then we have a total of 72,900 in the sixth year.

The natural checks to increase in this case are few. All the specimens that I have examined have been particularly well nourished, free from disease, and remarkably free from ecto- or endoparasites. The Little Owl would seem to be a particularly hardy and healthy bird, and very accommodating in its diet.

In the autumn there accumulates immediately beneath the skin, especially on the back and on the under side of the abdominal region, a thick layer of fat, which undoubtedly serves as a reserve food store. Moreover, of the 194 specimens examined, in only two have the stomachs been entirely empty.

Birds kept in captivity for 8 and 9 days and only supplied

with water did not appear to suffer at all, and only indifferently regarded earthworms, beetles and raw flesh, when placed in their cage. Correspondents speak of it as being able to subsist for a long time without food, but on this point I have no other evidence than the case here recorded.

Nesting and other Habits.—The nesting site may be in old buildings, the roofs of farm and other buildings, quarries, hollow trees and rabbit holes. Old willow stumps are often frequented, the site being only 3 or 4 feet from the ground. No nest is made, the eggs being laid on the bare wood or ground, very occasionally a few feathers or fragments of pellets forming a base.

Late in April or in May from 3 to 5 eggs are laid, though 6 and 7 have been recorded. The eggs are perfectly white and of a short oval form. Both male and female take part in incubating the eggs. The young birds remain in the nest for about 25 or 26 days, after which they can fly quite well, but for some little time they keep to the same tree in which the nest has been or one adjacent to the nesting site.

Dresser (8) quotes a statement by J. O. Keulemans as follows :—

"The Little Owl is very abundant all over Holland, especially in these localities where meadows with large bushes are found. In such places one sees extensive farmyards, which generally have an orchard at the back. These the Little Owl appears to frequent by preference, and seldom do such spots remain untenanted by these small birds of prey. I have often seen as many as six within an hour at different spots, so common are they. They are more often seen about the hour of twilight during the months of September, October and November, when migrating birds visit the country. They are frequently observed to fly long distances in the open fields in the daytime, rarely, however, without being pursued by a swarm of clamorous Starlings, House-sparrows, or even Crows and Magpies. Swallows also exhibit great aversion to this Owl, for no sooner do they spy one than a multitude assemble and fly round about it, chasing it from one spot to another."

"In Holland the bird is universally well known. They do not seem to drink much, as I have had them in a cage for more than a year without giving them any water. Indeed it is a curious fact that when they get wet, either by heavy rain or by being placed in a damp spot, they have fits and remain insensible for hours, and sometimes it causes their death. I had one once which I had placed on a boat near the bank while I was catching birds. The Owl saw its image reflected in the water and jumped in; and although I took it out immediately it was quite insensible, and to all appearance dead. Much regretting its loss, I put it into my pocket and carried it about for two hours, and on reaching home threw it down in a corner of the room. Hearing a noise in the middle of the night I went down, and to my great delight found my Owl jumping about on the table."

Although frequently seen about in the daytime, when it is heavy and stupid and not like the same bird, the Little Owl is most active after sunset and in the early morning before daybreak.

It is a remarkable ground feeder, getting over a considerable amount of ground and picking up practically all insect life that it meets with. At dusk it may be seen sitting on a post or tree trunk every now and then making short low flights often quite close to the ground. It will also search over the larger branches of trees for insects.

During the nesting season earthworms are largely taken for the young.

Opinions of Correspondents, etc.—The following notes from correspondents are of considerable interest:—

From A. A. C. (Suffolk).—"The Little Owl may do damage to game, but from my own observations I have thus far no evidence of that. We have a good head of partridges. One nest I found was on one of two isolated trees near a wood; game here and around was as plentiful as elsewhere. As far as I can prove, they are beneficial."

From C. M. A. (Surrey and Cambridge).—"At all the breeding haunts I have visited I have never found remains of either game birds or poultry, and one nest was within a few hundred yards of a farm" . . . . . . where there were "young chickens, ducks, and guinea fowl."

From G. P. (Monmouth).—"Although I cannot prove any criminality against them, they have a terrifying influence over game, and I have noticed particularly an entire absence of snipe in the locality they frequent."

From G. F. N. (Northamptonshire).—"I have found them very destructive among young pheasants. I once saw one take a pheasant about a week old and disappear into a hole in a tree. I shot it when it came out. I enlarged the hole and found eleven young pheasants and one wild duck a few days old and four young owls."

From A. H. B. (Somerset).—"I feel sure this wretched Little Owl, which never ought to have been introduced, must do a lot of harm. It looks far too innocent by day. I have often watched it, but cannot catch it red-handed."

From S. S. (Dorset).—"I cannot say that I have actually seen the Little Owl do any damage to partridge."

From G. K. (Northamptonshire).—"The Little Owl is very plentiful here and increasing. In their 'larders' I have found adult starlings, house-sparrows and other small birds, also bank voles and long-tailed field mice, but I have never seen any game. It may occasionally take a chick, but I have no proof. Their pellets contain large numbers of beetles."

From C. L. J. (Lincoln).—"I have seen them strike and carry off young pheasants and have found remains of young pheasants in and near the nests. I have never seen it attack adult game birds . . . They destroy a great quantity of rats, mice, and voles."

From C. R. (Essex).—"We have had Little Owls here for many years, and although there is plenty of game I have no actual proof that they destroy

it. In the 'larders' I have found young and adult starlings, chaffinches, house-sparrows, bank-voles, long-tailed field mice, one young rabbit, rats, and remains of frogs."

From J. C. L. (Hertford).—"We certainly lose a few young game birds each year due to the presence of the Little Owl, but I should not like to condemn it on that account, for considering the number of injurious insects, voles, rats and mice that it destroys practically during every month of the year, I consider it does far more good than harm. I have examined large numbers of its pellets and the evidence they provide is all in favour of this quaint little bird."

From R. B. C. (Suffolk).—"I cannot think they do much harm to game, as this has been quite a good partridge year, and I live on one of the great shooting estates. On the whole I think the case against the Little Owl is mainly one of 'giving a dog a bad name,' though I daresay they do sometimes take young game birds."

From G. H. G. (Sussex).—"I consider it is very harmful."

From W. H. H. (Essex).—"I am of opinion that the natural food of this bird is insects and larvæ in season, and small birds, etc., during the winter. I personally destroy this bird when chance occurs, as I think it harmful to poultry and young partridge."

From W. S. M. (Lincolnshire).—"I do not know of any case myself of injury to game birds; there are plenty of keepers who will swear to it, but that is not proof."

From F. H. (Kent).—"I have never seen them injure game birds."

From H. O. P. (Leicester). "I consider it quite harmless except during the nesting season. The bird is so small that it can get right into the coops and peck out a small partridge or pheasant, and its habit is to walk quietly up, consequently the old hen pays little attention to it, whereas a hawk arouses the suspicions of the hen foster-mother. They work by day and night. I have had complaint from local farmers that they come and remove chickens. Personally I have stopped the shooting of them and the keepers must watch their coops carefully during those three weeks or month."

From J. E. K. (Devon).—"So far as my own investigations go I have not yet found anything in those I have examined but beetles, a little moss or grass, and in the last one a few very small stones."

From C. T. F. (Middlesex).—"From what I have observed, I have come to the conclusion that the Little Owl is not to be feared. His favourite haunt here is in pollards growing alongside a ditch and I suspect that his favourite meal is a water rat. Judging by the number of partridge found this season I don't think the Little Owl can be harmful to them."

From H. J. F. (Hertford).—"My opinion (framed on facts) is the Little Owl *in the breeding season* does much harm to young game. After the young have flown, I personally have found very little trace of their damage to game."

From H. (Oxford).—"My experience of the Little Owl is that they are most destructive to young game birds, especially partridges, working as they do in the daytime. I am over-run with them here." *

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* On this estate 200 Little Owls were killed in 1920, and 23 in one shoot.

Depredations.—Numerous very serious charges have been made against the Little Owl: thus a recent writer (1) states: "The large amount of damage done by little owls to poultry and game has set all the gamekeepers and many others against it."

A large number of letters received from gamekeepers charge this bird with the destruction of young pheasants, partridges and fowls, also wild ducks and wood pigeons. Other correspondents have recorded the presence in their "hoards" or larders of the starling, blackbird, song-thrush, house-sparrow, chaffinch, greenfinch, linnet, skylark, cuckoo, bank vole, long-tailed field mouse, common shrew, rat, mole, rabbit, bat, snake and frog.

Some little time back this bird was reported to me as having been seen to carry off young pheasants. This occurred so often that the keeper shot the bird and sent it to me, but instead of an owl it was a sparrow hawk.

Mr. Meade-Waldo (12), who has paid considerable attention to the food of Little Owls, writes: "They are very large consumers of insects, beetles, earthworms, lizards, mice—and during the time the young are being fed, kill a great many birds. These consist almost entirely of young thrushes, blackbirds, mistle-thrushes, sparrows, chaffinches, greenfinches, some skylarks—just what one might expect; but the main point comes in the fact that, in all these years I have never *seen the remains of a single game-bird in a nest or 'hoard.'*" Later he writes (*In litt.*, 3 x 20): "We do not find them doing any harm now. All their castings consist of insect remains, beetles, etc. They hawk daddy longlegs, etc., all day and also at night, and we none of us found the remains of any young game birds in any nests that we carefully noted last summer. . . . I have had no complaints of chicken killing this year, and there are Little Owls in every farmstead."

Dresser (8) quotes Mr. Robson as stating that in Turkey and Asia Minor "It feeds much on the ground, principally subsisting on small beetles," and again De La Fontaine, that in Luxembourg "It feeds on small birds, mice and other small rodents, moths maybugs, etc. It is undoubtedly a most useful bird."

Mr. J. H. Gurney (10) writes: "There seems to be a prevailing prejudice against it, but the harm it does has been greatly exaggerated, in spite of what numerous letters to sporting papers may say to the contrary; at any rate, in the

south of France it is not looked upon with disfavour, and the test of dissection is rather in its favour than otherwise."

Atchison* records finding 74 young pheasants in a nest on a Cambridgeshire estate.

In reply to a circular letter sent to various correspondents, gamekeepers, etc., 23 state that in their opinion this bird is more injurious than beneficial, and 26 state it is more beneficial than injurious, while 28 state they do not know of any injuries.

Apart from the observations of Mr. Meade-Waldo, quoted above, none of these examinations are complete or extensive enough to affect the question, for we have an equally convincing series of opinions and isolated observations from both sides.

It is obviously wrong to condemn any species of bird because it destroys a certain percentage of young game birds, just as it would be to condemn another species because it destroys a certain percentage of cereals or fruit.

The question that lies before us is not whether the Little Owl destroys young game birds, but whether the percentages of other food items confer a benefit out of all proportion to the loss inflicted. In other words, we must have accurate figures showing the percentages of all the food items, for each month of the year, based upon a large series of stomach contents and pellets obtained from various localities, and such is the work we have endeavoured to carry out.

Migrations.—Many correspondents state that the Little Owls leave them, or almost so, during the winter months. In Leicester they are recorded as plentiful in the summer, but with the coming of autumn they mostly disappear, not returning until the end of April or early May. In Yorkshire they certainly move south with the return of winter.

A Lincolnshire correspondent writes (12th October): "Little Owls seem to have disappeared from this neighbourhood during the last six months. All the keepers, about ten, round here have had instructions from me to bring in any they caught, but not one has been seen."

Relation to other Wild Birds.—In considering the economic position of a bird like the Little Owl, it is highly important that attention should be given to the actual kinds of wild birds which it destroys and the percentage these bear to the total food bulk.

* Brit. Birds, 1912, p. 66.

The following list* includes the names of all the species destroyed of which I have reliable evidence :—

Species.	*Percentage destroyed.*
House-Sparrows	2·50
Mistle-Thrush	·50
Song-Thrush	·50
Blackbird	·60
Starling	2·25
Chaffinch	·55
Greenfinch	·45
Skylark	·25
Cuckoo	·20
Lapwing	·20
Wood-Pigeon	2·25
TOTAL	10·25

Of the eleven species there is only one that is wholly beneficial, viz., the lapwing; the cuckoo and skylark are partially so, while of the remaining seven there are undoubtedly too many at the present time, and 2 of them—the house-sparrow and wood-pigeon—must be regarded as distinctly injurious. I think we may therefore conclude that so far as the Little Owl is concerned in its destruction of wild bird life it constitutes a natural check upon a series of birds all of which are plentiful, and, as a whole, are not particularly beneficial. Its activities in this direction we may therefore regard as being beneficial.

I have no complete figures for the blackbird or cuckoo, but of the remaining species the food percentages are as follows :—

	Injuries.	*Benefits.*	*Neutral.*
Mistle-Thrush	21·00	35·50	43·50
Song-Thrush	17·00	37·00	46·00
†Greenfinch	22·00	6·50	71·50
House-Sparrow	62·75	12·50	24·75
Chaffinch	18·00	16·50	65·50
Starling	41·00	36·50	22·50
Skylark	13·00	36·50	50·50
Wood-Pigeon	62·00	1·50	36·50
Lapwing	—	70·00	30·00
Average	28·53	28·05	43·42

This table should be interpreted in the light of that above, in which the percentage of the different species destroyed is shown.

* Computed from the results obtained by an examination of stomach contents, pellets, and "hoards" or "larders."

† Approximate figures only.

Natural Enemies.—The two great enemies of the Little Owl are the gamekeeper who recklessly destroys everything but game, and the egg-collector. Of other enemies the bird has few, though it is frequently mobbed by house-sparrows and other birds.

(To be concluded, References to literature will be given in the concluding article.)

HULL AND DISTRICT ALLOTMENTS ASSOCIATION LIMITED.

W. N. Evans.

The allotment-holders' difficulty of security of tenure is about to be permanently solved for several hundred men in Hull by the Hull and District Allotments Association, Ltd. This Association, which has for its object the buying of land for allotments, owes its creation in 1920 to the enthusiasm and keenness of a few allotment-holders.

These men—who are mainly of the working class, and also several men who hold positions of responsibility with local business firms—had for some time discussed the question of purchasing land, and in June, 1920, a piece of land suitable for allotments came on to the market. This land was reasonable in price, but of much larger acreage than the Association required, being 21½ acres. They only wished to buy ten acres. The owner would not divide, so in the end they agreed to purchase the whole 21½ acres. The deposit money was raised amongst themselves. One must admit that these few men shouldered a great responsibility when, in June, 1920, they undertook to find by February, 1922, between £4,000 and £5,000 from an association of allotment holders not yet formed and without a penny of capital.

The Association was registered, and all people interested were invited to take up £1 shares, 2s. 6d. being payable on allotment with calls of 2s. 6d. per share every three months. Some people purchased the shares outright. The response to the appeal for subscribers was good, and to the present time the number of shareholders has steadily and continuously increased month by month. Propaganda work is carried out by the Chairman, Secretary and different members of the Committee, who visit the Allotment Societies in the city and district and explain the whole scheme to the allottees present. So far the Association

has only bought the one parcel of land mentioned above, situated on the Cottingham Road, Hull, of which possession will be taken in February, 1922.* As shareholders have come forward from all parts of the city, so also have come definite and insistent demands for the association to provide them with land. At the present time the Association is negotiating for more land, but they are proceeding with caution, as a policy of hasty purchase might easily land them in a difficult position. They are affiliated to the Agricultural Organisation Society whose model rules they adopted. The whole affair is run on as economical lines as possible. The Secretary and Treasurer (a combined post), the Chairman, and Committee, give their services gratis and also pay their own incidental expenses when attending meetings or addressing Allotment Societies, etc.

The greater part of the land has been planned out in the following approximate number of plots:—

136 plots of	300 sq. yards.
74 " "	400 " "
8 " "	600 " "

It is situated within five minutes' walk of the trams. This is a great consideration for allotment-holders as it makes their plots available without the waste of time involved in walking a long distance. The object of the Association is to buy land for allotments and not for building purposes, but as part of the present purchase abuts the Cottingham Road, which is in a residential district, it is ideal for building. Therefore the Association are offering the 600 yard and 400 yard plots as building plots, but the 300 yard plots can never be built on.

The prices charged for the plots are as follows:—

300 sq. yd. plots at	£15 15s. 0d. per plot.
400 " " " "	1s. 6d. " sq yd.
600 " " " "	3s. 0d. " " "

All purchasers must become shareholders. The Association arranged a scheme whereby members who wished could pay weekly sums on account, so that when they take over their plots in February, 1922, some will only have a small balance to pay. Many have taken advantage of this arrangement.

When the land had been planned out, a meeting of shareholders was called and different methods of allotting the plots to would-be purchasers were discussed. It was agreed to distribute on a mutual agreement basis. Each prospective buyer was to say which plot he would prefer, and if two or more men wanted

* Since the article was written the Association has completed negotiations for the purchase of 8½ acres of land situated on the Anlaby Road, Hull.

the same plot they were to settle the matter amongst themselves. This plan worked admirably. It had advantages over balloting inasmuch as it allowed friends to have plots adjoining each other (and on the other hand two men who could not agree could get away from each other); also a certain number of the 300 yard plots are directly at the rear of some of the 400 yard ones, therefore the plan of distribution allowed a man, who so wished, to buy a 400 yard plot for building purposes and have a 300 yard allotment immediately adjoining it.

The demand for plots has exceeded the Committee's most sanguine hopes. In fact, in the first instance they had reserved a piece of land adjoining the permanent allotments for " cutting up " in the future, but the demand has been such that they have already divided part of this reserve piece.

The question may be asked " What will happen to the Association when they have satisfied the demand for permanent allotments? " I asked them this question and briefly the answer was that they have in mind a scheme for supplying their members and the general public with all allotment requisites—seeds, " seed " potatoes, fertilisers, etc.,—in short, becoming a general allotment trading concern. If the Association does not attempt something on these lines, it must either spread its efforts over a continually widening area, or wind up, as one cannot continue indefinitely supplying permanent allotments to a small section of the community.

The successful launching of the whole scheme is due to the untiring energy of the Chairman, Secretary and Committee. I am sure that those who now, and in the future, become owners of permanent allotments through the instrumentality of this Association, will never appreciate to the full the amount of time and labour these officials have given; also the great responsibility they have taken with the sole public-spirited aim of benefiting the allotment-holder by solving the vexed question of security of tenure.

Ministry's Exhibit at the National Utility Poultry Society's Show.

THE Annual Show of the National Utility Poultry Society, held at the Horticultural Hall, Westminster, on December 6th-8th last, was opened by the Ministry's Permanent Secretary, Sir Francis Floud.

The Ministry's exhibits were divided into three sections, devoted mainly to educational propaganda in connection with poultry, rabbits and goats. They attracted a constant stream of visitors, and two technical officers of the Ministry who were in constant attendance at the stand throughout the show dealt with a large number of inquiries on various matters in connection with the keeping of poultry and small live stock. Sir Stewart Stockman, M.R.C.V.S., the Ministry's Chief Veterinary Officer, attended at intervals for the purpose of consultation by poultry keepers on questions of disease, and also gave an address on the same subject to a large audience in the Lecture Hall.

Among the exhibits (*see* Fig. 1), were charts giving particulars of :—

(1) Imports of Eggs and Poultry into the United Kingdom,
(2) Exports of Eggs and Poultry from Ireland (mainly to England),
(3) The Ministry's Egg and Day-old Chick Distribution Scheme.

An exhibit of exceptional interest, which was kindly lent by Principal Foulkes of Harper-Adams College, consisted of two live Wyandotte hens, in separate cages. These birds had given actual egg records of 285 and 91 respectively at the Harper-Adams College Laying Trials in 1919, and the object of the exhibit was to enable visitors to compare the visible characteristics of a typical good layer with those of a bad one. The difference between the two types shown was very noticeable, and provided a useful object lesson.

*Egg and Day-old Chick Distribution Scheme.**—By means of a map showing the situation of Egg and Day-old Chick Distributing Stations in England and Wales during the season 1921, visitors were able to note the extent to which different counties had adopted the scheme. One of the conditions of the scheme is that a poultry instructor must be employed by the County Education Authority in order to ensure that the conditions of the scheme are duly observed. Tables were also displayed showing the number of stations, and eggs and chicks distributed, in 1919, 1920 and 1921.

Early Elimination of Surplus Cockerels.—A very interesting exhibit showed the results of Professor Punnett's research work into sex inheritance. By crossing certain pure breeds of poultry which carry known Mendelian factors the sex of the chicks may be identified at the date of hatching.

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* Particulars of the Egg and Chick Distribution Scheme are contained in Leaflet 374/T.E. Copies may be obtained on application to the Publications Branch, Ministry of Agriculture, 10, Whitehall Place, London, S.W. 1.

FIG. 1. The Ministry's Exhibit at the Show of the National Utility Poultry Society.

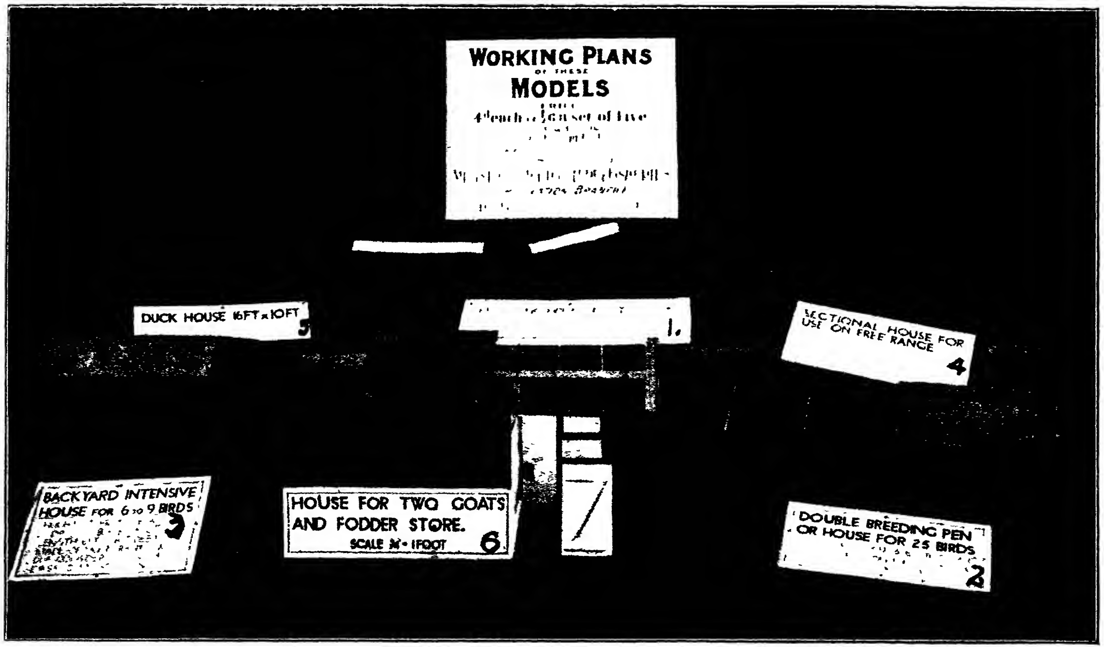

FIG. 2.—Models of Poultry Houses and a Goat House.

Models of Poultry, Duck and Goat Houses.—The models illustrated in Fig. 2 were also exhibited. They were designed to show how the stock can be housed under the most hygienic conditions, having due regard to soundness of construction and economy of space and material.

The Backyarders Intensive House (No. 3) is fully described in Leaflet 369 entitled "Backyard Poultry Keeping."*

Market Gardening combined with Poultry Keeping.—A diagram showing a suggestion for cropping a quarter of an acre divided into four parts, on which poultry are run in turn for three months whilst crops are being grown on the other three, was the centre of much interest, and many inquiries on the subject were received.

Rabbits.—Charts showing Imports of rabbit skins (Dressed and Undressed) into the United Kingdom for the years 1913, 1920 and 1921 were displayed. The quantities and values are as follows:

	Quantities.			Values.		
	1913	1920	1921	1913	1920	1921
Dressed	2,865,649	4,134,215	4,654,281	£116,164	£514,860	£341,409
Undressed	73,342,714	39,415,976	32,696,691	£701,440	£1,588,479	£666,978

A fine selection of prepared skins of the more important fur breeds of rabbits, and articles manufactured therefrom, were also shown. These were kindly lent by individuals and organisations commercially engaged in the production and sale of fur from home produced rabbit skins. It is interesting to note that such good prices as the following were being realised for articles made from first-class rabbit pelts:—Child's coat of "Blue Beveren" (silk lined), £8 8s. 0d.; "Havana" Stole, £12 12s. 0d., and muff to match, £5 5s. 0d. Other articles on view were purses, slippers and gloves, all made from rabbit fur.

Three specimen live rabbits were shown—Chinchilla, Havana, and Blue Beveren. The beautiful quality and texture of the fur of these animals were much admired by visitors.

Goats.—Photographs of prize winning milch goats were accompanied by literature and charts on the subject. Samples of goat's milk and cream were supplied. A model of a house for two goats and a fodder store was shown (*see* Fig. 2). Full particulars as to construction, etc., will be sent on application to the Ministry.

* Copies of the working drawings of the full-size houses represented by models No. 1 to 5 may be obtained on application to the Publications Branch of the Ministry, 10, Whitehall Place, S.W.1, price 4d. each post free, or the set of 5 for 1s. 6d. post free.

NOTES ON MANURES FOR FEBRUARY.

E. J. RUSSELL, D.Sc.,
Rothamsted Experimental Station.

Influence of Manures on "taking" of Clover Seed.—The past season has strikingly shown the effect of fertilisers on the "taking" of clover seeds. Eight different manures are tested each year on the Little Hoos rotation field at Rothamsted: last year clover was sown in the barley. As usual last season, the plant failed over much of the field, but the extent of failure was considerably influenced by the manure given to the previous crops. No manure was given to the clover. The seed was sown in April. The results were as follows:—

Fairly good plant:—after farmyard manure applied to previous crops, after bone meal, and to less extent after basic slag.

Poor plant:— after superphosphate, rape cake or shoddy applied to previous crops.

The results confirm previous experience here in showing the special value of farmyard manure for the clover plant. It appears that addition of farmyard manure to the crop preceding the clover favours the development of the plant and increases its yield. Non-acid phosphates are also beneficial.

Amount of Potash removed in Meadow Hay.—A correspondent asks how much potash is removed in meadow hay and what quantity of sulphate of potash or muriate of potash must be added to replace this amount? A 1½-ton crop of meadow hay contains about 50 lb. pure potash (K_2O) which would be supplied by 92½ lb. pure sulphate of potash, or 103 lb. sulphate of potash of the 48.5 per cent. grade, or 100 lb. muriate of potash of the 50 per cent. grade.

Amount of Phosphate and other Constituents in various Crops.—In continuation of the list given in the December Notes (p. 833) a correspondent asks for a similar list for phosphates, nitrogen and lime. The data for phosphates are:—

Phosphates removed as P_2O_5 (lb. per acre).

	Yield per acre.	*In grain.*	*In straw.*	*Total.*	*Equivalent to 30 per cent. superphosphate, lb. per acre.*
Wheat ...	36 bush.	17	8	25	184
Barley ...	40 „	16	5	21	154
Oats ...	50 „	15	7	22	162
Clover hay...	2 tons	—	—	25	184
Meadow hay	1½ „	—	—	12	88
Swedes ...	14 „	Roots only		17	125
Mangolds ...	30 „	„ „		49	360
Potatoes ...	12 „	Tubers only		43	316

The table shows the large amounts of fertiliser material removed from the soil by crops of the specified size, which, though good, are by no means excessive. Stated in terms of phosphoric oxide (P_2O_5) the figures do not seem imposing: they become much more striking, however, when expressed in the more familiar units of 30 per cent. superphosphate.

In the case of phosphates and of potash, removal in the crop is the most important source of loss from the soil, there being no significant washing out by rain, etc. In the case of nitrogen and of lime, however, removal by the crop is only one source of loss, drainage water removing much more serious quantities than of potash and phosphates. As against this, however, the clover crop returns a large and usually unknown amount of nitrogen to the soil. The crop figures are therefore of less importance since they represent only one of the three determining factors: they are, however, given here for the sake of completeness:—

Nitrogen removed: lb. per acre.

	In grain.	*In straw.*	*Total.*	*Equivalent to sulphate of ammonia (20°/₀ nitrogen).**	*Lime removed: lb. per acre. as oxide.**	*as carbonate.**
Wheat	41	19	60	300	11	20
Barley	35	14	49	245	9	16
Oats	38	20	58	290	13	23
Clover hay	—	—	98	490	90	160
Meadow hay	—	—	49	245	32	57
Swedes	Roots only		70	350	20	36
Mangolds	,,	,,	112	560	18	32
Potatoes	Tubers only		92	460	7	12

Although they represent only one source of loss the figures show that the exhaustion of nitrogen from a cropped soil is considerable, and they emphasise the need of ample nitrogenous manures for arable crops.

The large amounts of lime removed from the soil by clover and by meadow hay should be noted.

Spring Dressings for Cereal Crops.—The above table shows the demand for nitrogen made on the soil by a cereal crop: it is not surprising that nitrogenous top dressings give increases in yields. Some of the results obtained during the past season at Rothamsted are:—

Barley.

	Head corn bushels per acre.	*Total grain lb. per acre.*	*Straw cwt. per acre.*	*Total produce lb. per acre.*
No top dressing ...	25·6	1,554	17·1	3,473
Top dressing (sulphate of ammonia) ...	34·2	2,056	22·8	4,612

* See p. 832 for explanation of difference between these.

Thus in spite of the drought the barley responded satisfactorily to the nitrogenous dressing.

The results for wheat were not so marked; although there was an increase in crop it barely paid the cost of the dressing. Some of the figures are :—

Wheat.

	Head corn bushels per acre.	*Total grain lb. per acre.*	*Straw cwt. per acre.*	*Total produce lb. per acre.*
No top dressing ...	17·4	1,507	22·6	4,040
Top dressing (sulphate of ammonia) ...	18·6	1,605	25·8	4,497

Use of Ashpit Refuse as Manure.—The variable nature of this material and its dependence on season is shown by a recent delivery of London refuse which was found to contain more cinder than that delivered in the summer. During the hot weather household refuse appears to be poorer in cinders and therefore richer in fertiliser material than in winter.

Further information as to some of the northern towns' refuse has been supplied to the writer by Mr. R. W. Wheldon, of the Agricultural Department, Armstrong College, Newcastle-on-Tyne. At Cockle Park town refuse did not give as good results as farmyard manure when both were used at the same rate of 15 tons per acre, the crops of swedes being 25¼ tons with farmyard manure and 21½ tons with Gateshead refuse. It is possible, however, that the dry weather (which was felt even at Cockle Park, although one would not have imagined it from the yield of swedes) was not favourable to the town refuse. Elsewhere it gave satisfactory results on potatoes, and many farmers speak well of this particular material. It is offered at Gateshead at 2s. 6d. per ton and is cheaper than town stable manures. It is, however, richer in nitrogen than is generally the case, some samples containing up to 1 per cent. of this important fertiliser constituent.

Other ashpit refuse materials from towns are as follows :—

Percentage Composition.

	Tynemouth.	*Bury.*
Nitrogen	0·50	0·55
Phosphoric Acid (P_2O_5)	0·19	0·67
Equivalent to Ammonia	0·60	0·33
Equivalent to Tribasic phosphate of Lime ...	0·41	0·72
Potash (K_2O)	0·30	—
Organic matter	—	13·6
Mineral matter	—	52·0

Electric and Radium Fertilisers.—From time to time correspondents raise the question whether any particular value is

conferred on fertilisers by electricity or radium. There is no evidence that either of these agents increases manurial values, and farmers should not pay more for any fertiliser than is warranted by its chemical composition. It is easy to calculate from unit prices a fair value for an artificial manure, and anything paid in excess of this must be regarded as a speculation which may not justify itself.

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NOTES ON FEEDING STUFFS FOR FEBRUARY.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.).
Ministry of Agriculture and Fisheries.

Winter Feeding of Live Stock when Roots are scarce.—Arising out of a previous article (November, 1921, p. 725) several correspondents have written giving their practical experience. The two following extracts from letters received illustrate two methods of overcoming the difficulty, and are included here, owing to their practical interest.

Wintering Store Cattle with little or no Roots.—(1) "On a very light-land farm where I cannot grow any quantity of roots, I have been accustomed to winter 40 10-cwt. store bullocks. In 1919 they were fed on 2 lb. each decorticated ground nut cake and 2 lb. each linseed cake with barley straw, *ad lib.*; in 1920 a similar lot were fed on 4 lb. linseed cake and barley straw."

The method of feeding was as follows:—

"The cake was fed to the bullocks at 7 a.m., and then the mangers and racks filled up with barley straw and no other attention given until next day. Of course a plentiful supply of water was at hand. This method of wintering is cheap as regards labour, and from my experience successful.

"My experience of using treacle is not in its favour as I found it scoured the bullocks when given in only small quantities.

"This winter on another farm I am trying to fatten 40 9-cwt. to 10-cwt. bullocks on 4 lb. bean meal, 1 lb. ground nut cake, and 3 lb. linseed cake."

(2) Another correspondent writes:—

"This year I have been confronted with the difficulty of finding a method of feeding to compensate for the shortage of roots, as we have only half our usual crop. I have done this by substituting linseed and treacle, and I find it works out admirably.

"I have gone carefully into the day's mixing for the whole of the food. We do this one day for the next, so that the food stands in a heap 24 hours. We boil the linseed in a large copper, enough for three days each time of boiling.

"The treacle is mixed in cold water and thrown on the top of the food just before mixing. We use probably 25 buckets of water or so in the linseed and treacle altogether.

"The daily heap consists of:—

32 st. Straw chop.
12 st. Swedes.
12 st. Ground corn (wheat and oats).
6 lb. Linseed.
12 lb. Treacle.

"This heap is for 50 beasts. Each beast gets a server full twice a day and in addition a feed of hay.

"The proportion of treacle and linseed seems small, but it is sufficient to answer the purpose, causing the cattle to relish the food; singular to say, however, some of them refused to eat all up in the first week of feeding, but after that they cleaned up every bit, and there is not the slightest waste since.

"As to cost, this works out as follows:—

		£	s.	d.
Chop	4 cwt. at 4s.	1	12	0
Swedes	1½ cwt. at 2s.	0	3	0
Corn	1½ cwt.	0	12	0
Linseed	6 lb.	0	1	3
Treacle	12 lb.	0	1	0
		£2	9	3

"This is practically 1s. per beast per day (excluding hay).

"In thinking this matter over I came to the conclusion that two things would be required in forming a substitute for roots; the first was water, as you are well aware that there is a very large percentage of this in roots, and this is supplied by the addition of water. In the 25 buckets used, each cow would get half a bucket.

"The second thing required is something to keep the stomach in order and to prevent waste. This is amply done by the treacle and linseed, the feeding properties of which are greater than those of the roots.

"My idea of a first-class feed is one to keep the cattle in good health and growing steadily at reasonable cost, and I think that you will agree that in the above method, we are fulfilling this to advantage."

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	48/-	504	10 13	1 0	9 13	71·6	2/8	1·43
Barley, English Feeding	36/-	400	10 2	0 18	9 4	71	2/7	1·38
„ Canadian „	32/-	400	8 19	0 18	8 1	71	2/3	1·20
Oats, English White „	34/3	336	11 8	0 19	10 9	59·5	3/6	1·87
„ „ Black & Grey	31/-	336	10 7	0 19	9 8	59·5	3/2	1·70
„ Canadian	32/6	320	11 7	0 19	10 8	59·5	3/6	1·87
„ Argentine	27/3	320	9 11	0 19	8 12	59·5	2/11	1·56
Maize, „	36/-	480	8 8	0 17	7 11	81	1/10	0·98
Beans, English Winter	51/6	532	10 17	1 15	9 2	67	2/9	1·48
Buckwheat	56/-	392	16 0	...	...	...	...	...
Rye, English	39/-	504	8 13	1 0	7 13	72	2/1	1·11
Millers' offals—Bran	—	—	9 10	1 16	7 14	45	3/5	1·83
„ „ Coarse middlings	—	—	9 10	1 7	8 3	64	2/9	1·38
Barley Meal	—	—	12 15	0 18	11 17	71	3/4	1·78
Maize „	—	—	8 10	0 17	7 13	81	1/11	1·03
„ Germ Meal	—	—	10 2	1 5	8 17	85·3	2/1	1·11
„ Gluten-feed	—	—	10 5	1 11	8 14	75·6	2/4	1·25
Bean Meal	—	—	14 0	1 15	12 5	67	3/8	1·96
Fish „	—	—	16 10	5 10	11 0	53	4/2	2·23
Linseed	—	—	17 5	1 16	15 9	119	2/7	1·38
„ Cake, English (9°/$_o$ oil)	—	—	14 10	2 6	12 4	74	3/4	1·78
Cottonseed „ English (5°/$_o$ oil)	—	—	9 10	2 6	7 4	42	3/5	1·83
„ „ Egyptian (5°/$_o$ oil)	—	—	9 5	2 6	6 19	42	3/4	1·78
„ „ decorticated (7°/$_o$ oil)	—	—	14 0*	3 11	10 9	71	2/11	1·56
Cocoanut Cake (7°/$_o$ oil)	—	—	11 0	1 19	9 1	74	2/5	1·30
Groundnut „ (7°/$_o$ oil)	—	—	11 0	3 5	7 15	73	2/1	1·11
Palm kernel cake (6°/$_o$ oil)	—	—	7 15*	1 9	6 6	75	1/8	0·89
Feeding Treacle	—	—	7 0	1 1	5 19	51	2/4	1·25
Brewers' grains, dried, ale	—	—	10 5	1 11	8 14	49	3/7	1·92
„ „ „ porter	—	—	9 5	1 11	7 14	49	3/2	1·70
„ „ wet, ale	—	—	2 11	0 8	2 3	15	2/10	1·52
„ „ wet, porter	—	—	2 6	0 8	1 18	15	2/6	1·34
Malt culms	—	—	7 10	2 3	5 7	43	2/6	1·34
FARM VALUES.	—	—	Value per Ton on Farm.	Manurial Value per Ton.	Food Value per Ton.	S.E. per 100 lbs.	Value per	Market Value per lb. S E.
			£ s.	£ s.	£ s.		s.	d.
Potatoes	—	—	0 18	0 5	1 13	18	1/10	0·98
Swedes	—	—	0 16	0 3	0 13	7	1/10	0·98
Mangolds	—	—	0 15	0 4	0 11	6	1/10	0·98
Good Meadow Hay	—	—	6 9	0 18	5 11	31	3/7	1·92
Good Oat Straw	—	—	3 11	0 10	3 1	17	3/7	1·92
Good Clover Hay	—	—	6 19	1 4	5 15	32	3/7	1·92
Vetch and Oat Silage	—	—	2 5	0 8	1 17	14	2/8	1·45

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

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It will be noted from the above two extracts, that whereas the experience of one reader is in favour of the use of treacle, that of the other is against it. This apparent contradiction is due to the fact that treacle or molasses varies considerably in its laxative effect according to its origin and method of manufacture. Sugar cane molasses as a general rule is less likely to scour than beet sugar molasses. Owing to difficulty in handling, many farmers prefer to buy their molasses in the form of a molasses feed, and in such cases it is necessary to consider the character and nature of the substance used as an absorbent for the molasses. Many molasses feeds are on the market, and in buying these the farmer should ask himself two questions: (1) How much molasses is there present in one ton of the feed? (2) Is the absorbent material of feeding value? On the nature of the answer to these two questions, the value of the product largely depends.

Feeding Stuffs Table.—It will be noted that the allowance made for the manurial value of feeding stuffs is considerably less than in last month's table. The price of manures has dropped considerably, and the new values given in the table are based on the residual manurial value of the feeding stuff when the current unit values for nitrogen, potash and phosphoric acid are 14s. 5d., 4s. 9d. and 6s. 7d. respectively.

The table in question serves two purposes, *i.e.*, for comparison of purchased feeding stuffs, and for comparison of purchased feeding stuffs with home-grown produce.

In comparing the purchased feeding stuffs the price per lb of starch equivalent should be used as the guide to comparative cheapness. Thus, coconut cake at 1.8d. per lb. of starch equivalent is much dearer than palm kernel cake at .89d. per lb. of starch equivalent. On the other hand, in comparing home-grown produce the values per ton form the basis of comparison. The price per ton given in the table for farm values indicates the actual value of produce on the farm with purchased feeding stuffs at their current prices.

As explained in a previous article this figure gives an indication whether or not it is best to sell home-grown feeding stuffs, and to buy in purchased feeding stuffs.

THE following note has been communicated by Mr. H. Bradshaw, Beach Road, Cleveleys, Blackpool:—

Improvement of Grass Land in Lancashire.

In my capacity as Executive Officer I had exceptional opportunities of studying the grass land of the county. A large amount of this land is extremely well farmed, but it must be admitted that there is also a very large area which is badly farmed and not producing anything like the quantity of milk, beef and mutton that it is capable of producing. This latter class of land is to be found chiefly in the eastern part of the county on the coal measures and is a cold stiff clay. The herbage consists chiefly of bent, and through continued neglect the land is rapidly going back to moorland.

The basis of any improvement would appear to be lime. Nine-tenths of the farmers in East Lancashire, as the result of experience, say definitely that it is of no use applying manures to their land without first applying lime in some form.

Where a field is covered with a thick matting of bent it is no use applying a dressing of slag till this bent is got rid of, and nothing appears to get rid of it so well as a dressing of lime.* I have seen numbers of cases where slag has been applied to grass land and no results were visible. If, however, a dressing of lime was given, a marked difference in the character of the herbage was quickly seen, white clover taking the place of the bent. There is a pasture field situated within 6 miles of Manchester which, up to 1914, was let annually as a football field. Since 1914 football has not been played on it and no lime or manure applied. Whilst let as a football field the various touch lines were marked out with lime and these lines show to this day. Here the sward is quite green and full of clover whilst the remainder of the field is brown and benty.

My chief difficulty with farmers in these districts was in persuading them that lime was not a manure. A large number thought that if a field were limed every four years or so there was no necessity to apply any form of artificial manure. Others, however, are setting their neighbours an example of what can be accomplished by the use of lime and slag. Some landowners, too, are not behind in offering assistance to their tenants. In one case after I had inspected an estate of 5,000 acres and reported that lime was essential, the landlord made it known to his tenants that he was prepared to pay half the cost of liming.

* Mechanical treatment is recommended in the Ministry's Leaflet No. 275.

Needless to say a large number of the tenants took advantage of this offer.

A large number of small farmers in the vicinity of large towns, whose farms are wholly grass and who retail their milk, have let their land get into such poor condition that they now buy more milk than they produce. They are, in fact, little more than milk retailers. It is a common thing to find small farms carrying only one cow to every 4 acres. The pasture land is entirely neglected, never receiving manure of any kind other than the droppings of the cows in summer. The manure made in winter is applied to the meadows.

When these farmers are asked why they do not produce more milk they reply that their land is carrying as many stock as it can support and any increase in stock would necessitate buying feeding stuffs. They do not seem to grasp the fact that if they manured their pastures more grass of a better quality would be obtained, which would enable them to increase their stock and consequently produce more milk without the aid of feeding stuffs.

Potato Maturity Trials, 1921.

POTATO maturity trials were carried out in 1921 by the National Institute of Agricultural Botany at its Ormskirk Station. The object was to test a suggested method for (*1*) demonstrating the relative times of ripening of potato varieties, (*2*) establishing the relative yielding capacities of different varieties, and (*3*) determining the influence of place of origin of seed in respect to both maturity and cropping.

Equal weights of stocks of immune varieties comprising seven of the best known second earlies and two varieties on the borderlines of this group were obtained from several districts in England and Scotland. A single plot of each stock of all the varieties was planted, the whole forming a chequer-board which was so arranged that different varieties, and stocks from different districts were scattered over the area used for trial. At the end of the growing period the date on which each plot became mature was determined, and the produce of every plot was lifted and weighed as it matured.

Conclusive results could not be expected from a single year's trial, but the data indicate that the method adopted is sound, and that, when slight modifications have been made, reliable results of great practical and scientific value will be secured. Although the figures obtained so far must be regarded as

suggestive only, and the experiments require a further extension before any general conclusions can be drawn, it is advisable that they should be placed on record. They are, therefore, summarised below. The order of merit of the varieties for early maturity and for high yield are given in brackets.

Variety.	*Average time to mature (in days from planting).*		*Average yield (calculated in tons per acre).* Ware.	Chats.	Total.	
Dargill Early	(1)	77	5·1	·8	5·9	(9)
Nithsdale...	(2)	94	6·6	1·8	8·4	(8)
Arran Comrade	(3)	99	7·0	1·7	8·7	(7)
The Ally	(4)	119	10·0	·5	10·5	(5)
King George	(5)	121	11·5	·5	12·0	(2)
Great Scot	(6)	124	9·7	·6	10·3	(6)
K. of K. ...	(7)	130	10·9	·7	11·6	(3)
Tinwald Perfection	(8)	134	11·5	·8	12·3	(1)
Early Market	(9)	135	9·3	1·5	10·8	(4)

Though primarily arranged as a test of method, the figures would appear to justify the inference that when varieties are compared with each other a negative correlation between high yield and early maturity may be anticipated. The full data (which are not here reproduced) also suggest in respect to maturity that within a variety neither the place of origin nor the small irregularities in the soil of the trial ground have any material effect, but that both have a very considerable influence on yield.

These indications will be further tested this year. The same varieties will be used, but the system will be somewhat modified in the light of last season's experience.

World's Poultry Congress.

THE transactions of the First World's Poultry Congress held at the Hague, Holland, from 5th to 9th September, 1921, were recently published in two volumes.

Volume I—"Papers and Communications," is divided into four sections, which are as follows:—

(*a*) Experiments, investigations, science of breeding and its practical applications.

(*b*) State and other official action, including reconstruction.

(*c*) Hygiene and disease.

(*d*) The training and necessary qualifications of poultry instructors. Educating and demonstrating work.

Volume II.—Proceedings of the Congress.

These volumes contain reports on practical poultry work, poultry education, and investigations and research into diseases

of poultry, which are being carried on in Europe and other countries, together with a report of the actual proceedings of the Congress, which was attended by the largest gathering of persons interested in poultry keeping that has ever been known.

The reports are in the form of papers which were read at the Congress by the delegates from governments, research stations, universities and colleges, members of the more important societies, and well known commercial poultry breeders.

This unique collection of varied and up-to-date useful information on all matters referring to poultry should prove of inestimable value to all engaged in the development of the poultry industry in this country. Universities, colleges, farm institutes and other educational centres should endeavour to obtain these volumes for use in their libraries. Private and commercial poultry keepers should also obtain them as they contain the latest information on the various phases of the poultry industry.

Copies may be obtained from C. S. Th. Van Gink, Office of Secretary General, 30, Bezuidenhoutschewez, The Hague, Holland. The price of the two volumes is £1, plus 2s. 6d. postage. International post money orders must be used.

A supply of Volume I has been received by Mr. T. R. Robinson, 8, Vincent Square, Westminster, London, S.W.1, who will supply copies on receipt of 10s. 6d. plus 1s. for postage. Volume II will be available shortly.

Spraying Potatoes for "Blight" in Berkshire.

AN experiment which has been concluded after nine seasons' trials at the University College Farm, Reading, has yielded some interesting results with regard to the spraying of the potato crop with the ordinary field-horse sprayers. The College farm at Shinfield, where the trials have been carried out, is 200 ft. above sea level, and there is a general opinion that the rainfall is higher in the Thames Valley below. The economic value of spraying probably therefore holds over quite a considerable area, even in this comparatively dry part of the country.

During the course of the experiment four plots, of ⅛ acre each, were measured every year and treated as follows:—

(a) Not sprayed; (b) Sprayed once, early; (c) Sprayed once, late; (d) Sprayed twice, early and late.

The early spraying was given about the beginning of July, about a fortnight after potatoes were earthed up, and the late

spraying was given about a fortnight to three weeks later according to the suitability of the weather.

The crop was grown under the ordinary field conditions in ridges 30 in. apart and 14 in. between the sets. The manuring each year was constant, while a modified Bordeaux mixture was the spray adopted in each case, the ingredients used being 14 lb. of copper sulphate and 9½ lb. of lime to 100 gallons of water. Approximately 100 to 120 gallons of mixture were applied per acre at each spraying.

The following figures show the average yields per acre recorded throughout the trials, together with the average percentage of diseased tubers (by weight), and the average percentage of sound seed (by weight) of the total crop:—

	Not sprayed.		*Sprayed once, early.*		*Sprayed once, late.*		*Sprayed twice early and late.*	
	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.	cwt.
Average yields per acre for 9 years, 1911–20	7	5¾	8	4	8	4	8	10½
	percentage.		*percentage.*		*percentage.*		*percentage*	
Average percentage of diseased tubers for the period ...	5·49		5·44		4·03		4·09	
Average percentage of seed tubers for the period... ...	19·78		19·57		18·79		18·43	

The conclusions to be drawn from this experiment show that not only has spraying increased the total crop on the average, but it has also increased the percentage of sound saleable ware tubers.

The percentage of seed by weight shows a small reduction in the case of the sprayed plots, while on the chats spraying caused a definite reduction in percentage occurrence.

Spraying also reduced the percentage occurrence on the average of diseased tubers on all the plots and particularly in the late sprayed and double sprayed plots.

* * * * * *

The Hop Control.

THE Hop Control, which consists of a Board or Committee composed of representatives of hop growers, merchants, factors and brewers, acting under the chairmanship of the Hop Controller, was established by a minute of appointment of the President of the Board of Agriculture, dated 6th October, 1917, in order to secure the restoration of the English acreage under hops which had been reduced by earlier orders during the War. The

chairman of the board was not then called the Hop Controller, but was appointed as such by order of the Food Controller, dated 9th January, 1919, made after consultation with the Board of Agriculture and Fisheries. The powers given to the Food Controller in that order include the following:—

"(a) To take control of the hop industry; (b) to take over all such stocks of hops as may be from time to time determined; (c) to buy and sell hops; (d) to grant permits exempting any persons from all or any of the provisions of the Hops (Restriction) Order, 1917, as amended by the Hops (Restriction) Order, No. 2, 1917, subject to such conditions, restrictions, and upon such terms as the controller may think fit; (e) to enforce the due observance and performance of the said orders, and all such further orders respecting hops and for controlling the hop industry which the Food Controller may from time to time issue; (f) to issue such rules and regulations respecting hops, and for controlling the hop industry as he may from time to time determine; (g) to enforce the due observance and performance of the rules and regulations issued by him, and such further rules and regulations as he is by this authority authorised to issue."

A further order of 14th May, 1920, called the Hops (Restriction on Delivery) Order, 1920, made by the Food Controller, prohibited any person from taking delivery of any hops arriving in the United Kingdom after 10th June, 1920, except under licence of the Food Controller. In the earlier years of control, importation had been entirely prohibited.

It should be borne in mind that this control was set up at the urgent request of the hop growers and merchants, many of whom feared the extinction of the industry.

The powers thus conferred were subsequently dealt with in section 4 of the Ministry of Food (Continuance) Act, 1920, which ran as follows:—

"4.—(1) With a view to assisting the industry of hop growing in the United Kingdom to recover from the injury which it suffered during the War, the Food Controller during the continuance of his office shall have, and exercise, any powers in relation to hops which at the time of the passing of this Act were exercisable by him, and may by order prohibit or regulate the importation of foreign hops in such manner as may appear to him necessary. . . . .

(2) An order under this Act providing for the transfer of the powers of the Food Controller under this section to any other government department or departments may, notwithstanding anything in this Act, provide for the continuance of the power so transferred until the expiration of a period of five years from the passing of this Act, and in such case the provisions of this Act, so far as necessary, shall continue to have effect accordingly."

The final power was the order in council of 24th March, 1921, made by His Majesty in accordance with the section quoted above transferring the powers of the Food Controller under that

section to the Minister of Agriculture and Fisheries, under whom the hop control is therefore continued. The order in council provided for the continuance of the powers until 16th August, 1925, *i.e.*, until the expiration of the period of five years from the date of the passing of the Act.

It should be mentioned that in the first period of its existence the hop control was given a state guarantee against loss, which enabled banks to finance its operations at a favourable rate of interest, but later that was discontinued. No charge, however, has at any time fallen upon the State, since the sale of the hops brought into the control has always covered the costs of the operations. The control buys all hops produced in this country and sells them to brewers. Its price is fixed in advance for each crop and is based upon the average cost of production after allowing a reasonable profit to the grower. The prices per cwt. have been as follows:—for the 1917 crop, £7 15s.; 1918 crop, £16 10s.; 1919 crop, £18 5s.; 1920 crop, £17 10s.; and the 1921 crop, £18.

The pre-war acreage of hops was about 36,000 acres, which was reduced during the War to about 15,000 acres. The acreage in 1921 was over 25,000 acres. In the three previous years it was about 15,600, 16,700 and 21,000 acres respectively, so that it is clear that the policy of hop control is effecting the object for which it was instituted.

A special point as to importation of hops is worthy of notice. It is an essential part of the policy of the hop control to release foreign hops only after the English crop has been taken up at the controlled price. Therefore, though brewers may, at their own risk, contract for the purchase of foreign hops, they can only obtain authority for their delivery up to an amount to cover existing requirements—but not to build up stocks to the prejudice of future crops—after the English crop is disposed of, and they have bought up their fair share of it.

New Onion Smut Order.

IN May, 1920, an Order for the control of the disease known as "Onion Smut" was issued by the Ministry. This Order enabled the Ministry to take immediate action should the disease be found in other parts of this country. No further outbreaks of the disease have been reported, however, and recent research has revealed adequate measures for its treatment. A new Order has therefore been issued containing less stringent

but equally effective regulations. The new Order provides that the sowing of onion or leek seeds or the planting of seedlings in land known to be infected may be carried out only under licence from the Ministry; such licences will be granted only after certain prescribed measures of treatment have been adopted. The distribution of onion or leek plants from infected land is also subject to control.

Copies of the Order in question, "The Onion Smut Order of 1921" (S.R. & O., 1921, No. 1620), may be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, W.C.2, price per copy 1d. net.

Licensing Stallions under the Horse Breeding Act, 1918.

STALLION owners in England and Wales who intend to travel their stallions during the 1922 season are reminded again that they will require licences from the Ministry to enable them to do so, and that as the Ministry cannot undertake to issue licences at very short notice, owners of stallions who postpone the necessary application may experience considerable delay in obtaining them.

With the approach of the Spring sales and shows, it should also be noted that a licensee is required to give notice forthwith to the Ministry of any sale, or letting for a period exceeding six months, or other change of the ownership of a licensed stallion. The licence should be given to the purchaser or lessee who should apply immediately to the Ministry for a new one, as the existing licence ceases to be in force at the expiration of one month after the change of ownership. A new licence will be issued free of charge. Any contravention of the Act in this respect renders the offender liable to a fine not exceeding £5.

Director of Kew Gardens.

LIEUT.-COL. SIR DAVID PRAIN, C.M.G., C.I.E., F.R.S., will shortly retire from the post of Director of The Royal Botanic Gardens, Kew, which he has held since 1905, and the First Lord of the Treasury has appointed as his successor, Mr. A. W. Hill, Sc.D., M.A., F.L.S., who has been Assistant Director of the Gardens for the last fourteen years, and was previously Fellow and Dean of King's College, Cambridge, and University Lecturer in Botany.

Erratum.—With reference to the article on "Insecticides and Fungicides" which appeared in the October, 1921, issue of this *Journal*, it is regretted that the percentage of hydrocyanic acid which sodium and potassium cyanides are respectively capable of evolving was incorrectly stated on p. 631. In the case of sodium cyanide the percentage of hydrocyanic acid should read 54 instead of 56, and in the case of potassium cyanide 39·4 instead of 43·7.

Foot-and-Mouth Disease.—No further outbreak of foot and-mouth disease has been confirmed in any part of Great Britain since that near Sevenoaks, Kent, on 24th November last, referred to in the January issue of the *Journal*. The measures adopted by the Ministry were successful in preventing any extension of that outbreak, and the restrictions were withdrawn as from 19th December, 1921.

Leaflets issued by the Ministry.—Since the date of the list given on p. 954 of the January *Journal*, the following three new leaflets, of which those marked with an asterisk will, provisionally, be supplied free, have been issued :—

No. 380.—The Making of Fruit Pulp (Formerly F.P. 41).
" 381.—How to Keep Swine Fever away.*
" 383.—Hints on Goat Keeping.*

The following have been revised or amended :—

No. 44.—The Lapwing, Green Plover or Peewit.
" 134.—Profitable Apples for Market.
" 166.—Some Common Thistles.
" 195.—American Gooseberry Mildew.
" 210.—The Oyster-Shell Scale.
" 302.—Silver Leaf in Fruit Trees.
" 306.—The Goat as a Source of Milk.
" 328.—Smut in Oats and Barley.
" 334.—Potash Fertilisers.
A316/I.—Abridged list of Publications.*

The following Leaflet has been rewritten :—

No. 297.—Seed Testing.*

The following Leaflet has been temporarily withdrawn :—

No. 300.—The Breeding of useful Pigeons.

Distribution of Leaflets.—Persons who require information on a definite point dealt with in one of the leaflets, can obtain the leaflet in question free of charge, but if several leaflets are required, a charge will be made at the rate of 1d. each or 9d. per dozen, post free.

NOTICES OF BOOKS.

The Wheat Plant.—(John Percival, M.A., F.L.S., Professor of Agricultural Botany at University College, Reading: pp. 463: 63s. net: Duckworth & Co.). The agriculturist—student, farmer, scientist—has again and again been heard to ask "What is the best book about Wheat?" He has been referred to Körnicke in the German or Vilmorin in the French, but in English, with a few inconspicuous exceptions, there has been no book to recommend. This should not be regarded as an indication of ignorance on the part of English-speaking agricultural botanists nor of inertia, but it is due simply to the difficulty of collecting a vast mass of fact from an almost limitless field. The field is wide because the growing of wheat is a staple of English farming, its preparation for food involves big industries, and the scientific problems it presents have attracted research-workers from every department of botany and chemistry. He who would write a book about wheat, then, must cast his net wide and have it very fine or he will surely miss something that one or another of a host of expectant readers would have him deal with. Whatever may be felt about this book it will at any rate be granted that Professor Percival has essayed to add something entirely new to English agricultural literature.

The book is in two sections, and throughout it is adorned—there is no other word—with the beautiful drawings and photographs that are to be expected from its author.

Part I describes the anatomy, the structure of all the parts, of the wheat plant. Every detail of leaf, stem, flower and grain is accurately portrayed, from the sprouting of the seed in the soil to the time when the plant is ripe and ready to harvest. The root-system, the part upon which so much depends but to which farmer and botanist alike are apt to pay so little attention, is fully treated. Further, what is rare in books upon cereals, there is an explanation of the part which the roots play in "lodging." "quality" or "strength" of grain finds a place, but, as many will feel, an inadequate one. The miller has strong views upon the "kind" of wheat he desires—what English farmer does not know that his wheat makes less per quarter than the "strong" wheats of America, and elsewhere?—and the chemist has sought to describe in his own language the kind of wheat that will make the large, well-risen loaf. These things the author barely mentions, and perhaps the reason is disclosed by a passage in the second part: "So-called 'strength' of grain is important, but wheats of the highest quality in this respect invariably give small yields, and the consumer or his agents rarely pay enough for the superior quality to cover the loss due to diminished yield. It usually pays the producer to grow wheat of inferior milling quality, and this has been specifically recognised and adopted as a sound policy by the most successful wheat growers during the last two hundred years in this country." Time alone can be the critic of this pronouncement, but science would be wanting if it accepted fatalistically the dogma that high yield cannot be combined with a quality at any rate considerably superior to that of most of the wheats grown in England during the last two hundred years. Not a few, indeed, are convinced that this has already been abundantly disproved.

Part II consists in the main of the systematic classification, the cataloguing, of all the kinds of wheat upon which the author could lay hand. They came to him from every part of Europe, from India, from Persia, from America, from Japan, from Australia, from nearly every quarter in which wheat grows, and are marshalled into groups and sub-groups according to their varying characteristics. Botanists who do this kind of work are a quarrelsome set and the three new "races" (sub-groups) that the author has added to his catalogue of wheats will stir up contention. Some of the world's wheat tracts, Mesopotamia for example, are still imperfectly known to botanists, and their exploration may make yet another re-sorting of the catalogue necessary, but those whose interest is non-critical and lies in the strange multiplicity of the world's wheats may here regale themselves with descriptions and excellent photographs.

Into the last hundred pages is compressed the matter that, for practical purposes, is the most important of all. There is a chapter on "variation" wherein "sport" forms of wheat are described and a brief explanation is given of the use of "statistical methods," the checks which serve to show whether the numbers and measurements obtained in experiments are or are not likely to be misleading. The professional statistician may here raise his complaining voice, for the author has, all through, omitted to test, in this way, the numbers and measurements which he has so abundantly furnished.

Nowadays most of our wheats are "hybrids," and Professor Percival gives a survey of the laws of inheritance which have been disclosed by the breeding of hybrids and an account of some strange "mongrels" out of wheat crossed on to barley or on to rye. Pessimism runs through the chapter on "Improvement and Breeding of Wheat." Mendel's discovery receives its tribute but we read, "most of the characters whose inheritance has been clearly established are of no economic importance" . . . "the grain-yielding capacity of the plant . . . either does not Mendelise or is at present beyond Mendelian analysis . . . " In so saying, the author displays the caution which an exceedingly difficult problem necessitates, but the omission of what has been done in this important direction is regrettable.

Very appropriately, a chapter on "Yield" concludes the text. Yields in the different countries of the world, yields in ancient times, the influences of manuring, cultivation, large and small seed, high and low seed rate—all these are briefly reviewed. Perhaps wisely, the author scarcely hints at an attempt to analyse "yielding power"—to specify the features of the different wheat varieties that make them heavy or poor yielders. He might usefully have trod firmer ground, however, by describing how to "test" yielding-power accurately. A bumper crop one year on an experimental plot or even on a field is not sufficient to stamp a "variety" as an exceptionally high yielder, and accurate methods of testing yielding-power are to-day almost pre-eminently important in crop-work.

The diseases of the wheat plant and their treatment constitute a great subject on which admirable and successful work has been done. An account of this would have enhanced the value of the monograph, but perhaps it ought to be considered beyond its scope. Technical readers may, indeed, be constrained to feel that not one but a series of monographs from more than one pen is necessary to present all that is known about the wheat plant.

A book about wheat must have a horde of critics: but the general agricultural reader will find collected here what he must seek in vain in any other single volume in English.

Practical Gardening for Pleasure and Profit.—(The Educational Book Company Ltd., 17 New Bridge Street, London, E.C. Price £4 5s. art vellum, or £5 14s. art canvas, net, for six volumes.) The first volume of this work deals with gardening practice; with gardens suitable for houses in various situations in country, town and suburb; with school gardens, etc. The second treats almost exclusively of vegetable crops, but includes much useful information concerning allotments. In the third volume fruit growing, as it should be practised in small gardens, is dealt with in a way which will commend itself to most growers of fruit for domestic purposes. In the fourth volume the subject of gardening under glass is considered at length, and a useful encyclopædia of indoor plants has been included. The fifth and sixth volumes deal with the growing of flowers, a subject which interests almost every section of the community.

In the past few years an immense development has taken place in practical gardening and horticulture generally, and there was a need for a comprehensive work of this nature, and "Practical Gardening" will be much appreciated.

This work, which has been edited by Mr. Walter P. Wright, the well-known writer on gardening subjects, who for a long time has been the Horticultural Superintendent in Kent, has been presented in a simple and interesting style. Mr. Wright has been fortunate in securing other well-known horticulturists to contribute to sections of the work in which they possessed expert knowledge. The scientific and practical value of the work has been increased by the addition of articles from authorities such as Sir Harry Veitch, Messrs. Edwin Beckett, M. C. Allwood, W. Cuthbertson, Joseph Cheal, and R. W. Wallace, all well-known practical horticultural men; together with contributions on scientific subjects from such reliable writers as Dr. E. J. Russell, Mr. F. J. Chittenden, and others.

The presentation of the book is exceedingly good, and it is abundantly illustrated with most excellent drawings and photographs, some of which are coloured. The inclusion of these makes it more easily understood, and adds to the attractiveness of the whole work, which is a valuable addition to horticultural literature. H.V.T.

The Swedish Agricultural Labourer.—(Published by order of the Swedish Government's delegation for International Collaboration in Social Politics, Stockholm, 1921.) The prospect of an international discussion on the economic conditions of agricultural labour in Europe led the Swedish Government to issue this monograph, which gives much interesting and valuable information regarding a subject that is little known to English students. Of the eleven short chapters only one, the first, is devoted to general agriculture, and even this is prepared with the object of elucidating the origin and causes of the conditions which are subsequently described. The remaining chapters deal with such questions as the number and distribution of agricultural labourers in Sweden, their wages, hours of work, housing and right of combination, the labour of women and children, insurance against old age, sickness and accident, technical instruction and land settlement. English readers will perhaps be most impressed by the primitive and almost

patriarchal conditions that still prevail in many parts, reminiscent in many respects of mediæval England, and the feudal system. We learn on p. 25 that there are no fewer than 59,650 male and 4,135 female small holders, known as *torpare*, who correspond with the mediæval villein. In certain districts the crofts are owned by the occupiers, but in the eighteen more southerly counties of Sweden, 33 per cent. are let to persons who undertake as part of the duties of their tenure to carry out a certain number of days' work on the landlord's farm. The system, however, is disappearing, as might be supposed, in favour of a money rent. Again, there are a body of farm servants, known as *statare*, who, instead of being fed in the house of their employer receive a food allowance which they consume at home. Many of these, however, have commuted these allowances for an allotment of land and fodder for their cow. As is pointed out in the pamphlet, the number of kinds of agricultural labour is great, and while one type will prevail in one district it can hardly be found in another. The variations are due chiefly to the size of the holdings, and the conditions, principally climatic, under which the industry is carried on. The whole book deserves careful study by all who are interested in the conditions of agricultural labour in foreign countries.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Russell, E. J.—Soil Conditions and Plant Growth. (4th Edition.) [The Rothamsted Monographs on Agricultural Sciences.] (406 pp.) London: Longmans, Green & Co., 1921, 16s. [63.115; 63.161.]

Haas, P. and *Hill, T. G.*—An Introduction to the Chemistry of Plant Products. Vol. I. On the Nature and Significance of the Commoner Organic Compounds of Plants. (3rd Edition.) (414 pp.) London: Longmans, Green & Co., 1921, 16s. [58.11; 54(02).]

Bosanquet, R. C.—The Beginnings of Botany: Some Notes on the Greek and Roman Herbalists. (20 pp.) Edinburgh: Neill & Co., Ltd., 1919. [58(04).]

Everall, Wm.—Farmers' Account Book. (4th Edition, revised.) (50 pp.) Published by the Author, Exchange Offices, Shrewsbury, 1921, 10s. 6d. [657.]

Game and Heather-Burning (Scotland) Committee.—Report of the Committee with the Minority Report. (35 pp.) London: H.M. Stationery Office [Cmd. 1401.] 1921, 6d. net. [343.771; 63.26; 63.142.]

Royal Commission on the Importation of Store Cattle.—Report of the Commissioners. (15 pp.) [Cmd. 1139.], 2d. net.

Proceedings before the Commission, Minutes of Evidence and Appendices. (605+LXXIV pp.) [Cmd. 1541.], 35s. net. London: H M. Stationery Office, 1921. [63.6: 38; 382.]

Salter, M. de Carle S.—The Rainfall of the British Isles. (295 pp.) London: University Press, 1921, 8s. 6d. [551.5.]

Department of Scientific & Industrial Research.—Statistical Supplement to the Final Report of the Nitrogen Products Committee of the Ministry of Munitions. (22 pp.) London: H.M. Stationery Office, 1920, 1s. net. [63.1671; 668.6.]

Merchandise Marks Committee.—Report to the Board of Trade. (16 pp.) London: H.M. Stationery Office [Cmd. 760.], 1920, 2d. net. [343.53(b).]

Plant Diseases.

Sanders, T. W.—Fruit Foes. (111 pp. & 27 coloured plates.) London: W. H. & L. Collingridge, 1921, 4s. [63.24-41; 63.27-41.]

Dairying and Food, General.

Richards, Miss I.—Modern Milk Goats. [Lippincott's Farm Manuals.] (271 pp.) Philadelphia & London: J. B. Lippincott Co., 1921, 12s. 6d. [63.638.]

Orla-Jensen, Dr. Phil.—Dairy Bacteriology. (180 pp.) Translated by P. S. Arup. London: J. A. Churchill, 1921, 18s. [576.8 : 7.]

Vermont Agricultural Experiment Station.—Bulletin 213:—Cold Storage of Cottage and other Soft Curd Cheeses. (22 pp.) Burlington, 1919. [664.8.]

Board of Trade.—Standing Committee on Trusts. Profiteering Acts, 1919 & 1920.—The Suppressed Minority Report of the Final Report on Meat. (10 pp.) Manchester: Express Co-operative Printing Co., Ltd., 1921. [63.75; 338.8.]

Ministry of Food.—4th, 5th and Final Reports of the Departmental Committee on the Wholesale Food Markets of London. (25 pp.) London: H.M. Stationery Office [Cmd. 1341.], 1921, 4d. net. [381.1.]

Poultry.

Brown, E. T.—The A.B.C. of Egg Production. (89 pp.) [The Smallholder Library No. 18.] London: C. A. Pearson, Ltd., 1921, 1s. 6d. [63.651(02).]

Canada Department of Agriculture, Dominion Experimental Farms.—Bulletin 87:—The Principles of Poultry House Construction with General and Detailed Plans. (43 pp.). Ottawa, 1920. [63.6 : 695.]

Engineering.

Society of Motor Manufacturers and Traders.—Report on the Tractor Trials held at Shrawardine, nr Shrewsbury, Sept. 20-24, 1921, 2s. 6d. [63.175.]

Ministry of Transport.—Report of the Rates Advisory Committee on the Interim Revision of Railway Rates, Tolls, Fares and Charges, July and October, 1920. Part III:—Fares Lower than Ordinary and Services Rendered Free or at Nominal Charges. (15 pp.) London: H.M. Stationery Office [Cmd. 1148.], 1921, 2d. net. [378.]

Economics.

Duncan, J. F.—Agriculture and the Community. (119 pp.) London: International Bookshops, Ltd., 1921, 2s. [338.1.]

U.S. Department of Agriculture.—Bulletin 999:—Prices and Farm Products in the U S. (72 pp.) Washington, 1921. [338.5.]

SELECTED CONTENTS OF PERIODICALS.

Veterinary Science.

The Cause of Black Disease and Its Method of Transmission. Being Further Studies in a Braxy-like Disease of Sheep, *S. Dodd.* (N.S.W. Agr. Gaz., June, 1921.) [619.3.]

Poultry and Bees.

Genetic Studies in Poultry. III.—Hen-feathered Cocks, *R. C. Punnett* and *P. G. Bailey.* (Jour. Genet., Vol. xi, No. 1, April, 1921.) [575.1.]

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 12.

MARCH, 1922.

NOTES FOR THE MONTH.

Foot-and-Mouth Disease.

On 24th January outbreaks of Foot-and-Mouth Disease were confirmed in lairs at Newcastle, at Seaham Harbour (Durham) and at Hessle near Hull in the East Riding of Yorkshire. The affected cattle in the Newcastle outbreak had been exposed with others in Morpeth Market on 16th January and at Newcastle Market on 17th January. As other consequential outbreaks were therefore to be anticipated a wide area was scheduled, including the whole of Durham and a large part of Northumberland, in which movement of animals was prohibited. An area was also scheduled around Hull.

These cases proved to be the forerunners of the most widespread outbreak of Foot-and-Mouth Disease which this country has known since 1884. Up to Sunday, 19th February, no fewer than 787 outbreaks on separate premises were confirmed in the whole of Great Britain, and 65 other reports were under investigation. The confirmed outbreaks numbered 787, distributed, as shown in the following table, in 27 counties in England, 1 county in Wales, and 11 counties in Scotland:—

England and Wales.				*Scotland.*	
Bedfordshire	1	Norfolk	15	Berwickshire	2
Cambridge	2	Northumberland	30	Dumbarton	1
Cheshire	31	Nottinghamshire	13	Dumfries	1
Cumberland	4	Salop	1	Fifeshire	3
Derbyshire	5	Staffordshire	3	Forfarshire	8
Durham	69	Suffolk	4	Lanarkshire	7
Essex	7	Surrey	1	Linlithgow	1
Hants	1	Warwickshire	1	Midlothian	9
Kent	1	Westmorland	19	Perthshire	6
Lancashire	79	Yorkshire E.R.	117	Renfrewshire	14
Leicestershire	2	Yorkshire N.R.	70	Stirling	5
Kesteven	1	Yorkshire W.R.	230		
Lindsey	17	Denbighshire	1	Total	57
London	2				
Middlesex	3	Total	730		

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The present policy of the Ministry in dealing with Foot-and-Mouth Disease is the "stamping out" policy, that is, the extermination of the virus of the disease by the immediate slaughter of affected animals, and of other animals which, owing to their direct contact with the former, are certain to become infected. As the virus of the disease can be carried long distances by the feet of other animals, or by the feet and clothes of persons, and even by birds or by the wind, the disposal of affected stock as promptly as possible is the most effective means of eradication. In pursuit of this policy the Ministry had up to 19th February authorised the slaughter of 17,249 cattle, 7,850 sheep, 6,788 pigs and 33 goats.

The origin of the outbreak is still obscure, but the evidence so far available points to the fact that many markets were infected before disease was reported to the Authorities. The following is a list of infected markets (ascertained up to 19th February) and the date when it appears diseased animals were exposed thereat:

England.	
Newcastle	14th Jan.; 23rd Jan.
Hull	17th Jan.; 23rd Jan.
Gateshead	24th Jan.
Northallerton	25th Jan.
York	26th Jan.
Wakefield	27th Jan.
Doncaster	24th Jan.
Worksop	25th Jan.
Carlisle	21st Jan.
Kendal	23rd Jan.
Manchester	27th Jan.
Chester	26th Jan.
Crewe	23rd Jan.
Market Drayton	25th Jan.
Stockton	25th Jan.
Darlington	23rd Jan.
Preston	27th Jan.
Stanford-le-Hope	27th Jan.
Bradford	24th Jan.
Otley	27th Jan.
Malton	28th Jan.
Leeds	24th Jan.
Norwich	28th Jan.; 4th Feb.
Ipswich	30th Jan.
Sheffield	Uncertain.
Islington (London)	31st Jan.
Scotland.	
Berwick	27th or 28th Jan.
Glasgow	25th Jan.
Edinburgh	Date uncertain.
Stirling	26th Jan.
Dundee	31st Jan.
Greenock	31st Jan.
Paisley	30th Jan.
Perth	20th Jan.; 27th Jan.

Up to 19th February no fewer than 142 outbreaks had been traced directly to infection contracted at these markets, and inquiries with a view to tracing the chain of infection more completely are proceeding. It is also known that on 21st January a consignment of 44 cattle was shipped from Hull to Antwerp and that 5 of these animals on arrival at Antwerp showed lesions of Foot-and-Mouth Disease.

As soon as it became evident—on 30th January—that diseased animals must have been exposed at the above-mentioned markets,

restrictions on the movement of stock, which at first had been confined to the counties of Durham, Northumberland, Yorkshire and parts of Nottinghamshire and Lincolnshire, were extended to the whole of the North of England from the Scottish border to Staffordshire.

On 31st January disease was confirmed at Glasgow and at Gorgie market, Edinburgh. It appeared that the animals concerned in the Glasgow outbreak had passed through Glasgow market on 25th January. The Ministry thereupon as a precautionary measure applied control of movement over the whole of Scotland south of a line from Aberdeen to Dumbarton, and the wisdom of this step was proved by the subsequent outbreaks in the counties of Lanark, Renfrew, Stirling, Forfar, Perth, Dumbarton, Fife, Berwick and Dumfries. It was hoped that the above areas would include all centres to which the disease might have spread from the markets. This unhappily proved not to be the case, as on 2nd February disease appeared at Biggleswade in Bedfordshire, around which an area was at once scheduled, on 4th February at Rochford (Essex), and in Denbighshire, outside the north of England area. On Sunday morning, 5th February, disease was also confirmed in Norwich cattle market.

The position at Norwich market was specially difficult as several hundred animals were detained at the market at the time the disease was confirmed, and arrangements had to be made for the disposal of these as far as possible for slaughter locally. Others, for which no slaughtering accommodation was available, were licensed under special precautionary conditions direct to slaughterhouses in other towns. 20 trucks of cattle which were on their way south were held up at Chelmsford and dealt with there.

It was clear that there were other centres of which the Ministry was not yet aware, and after careful consideration it was decided on Sunday morning, 5th February, to place the whole of Great Britain under control of movement of animals by licence, and to prohibit the holding of markets of livestock except for immediate slaughter so that the meat supply should be maintained. The Order issued on that date divided Great Britain into five separate Scheduled Districts, namely:—(1) The N.-W. of Scotland; (2) the S.-E. of Scotland; (3) the N. of England; (4) the S.-E. of England; (5) the S.-W. of England, and Wales.

All movement of cattle, sheep, pigs or goats within these districts was prohibited except for necessary purposes and then by licence of the Local Authority Inspectors. The Order also prohibited movement from one of these Scheduled Areas to another,

except direct to a slaughterhouse by licence. The movement of any stock out of the most densely infected areas was entirely prohibited, *i.e.*, out of (*a*) Durham and the greater part of Northumberland; (*b*) the southern half of the West Riding of Yorkshire; (*c*) the East Riding of Yorkshire; and (*d*) Cheshire. Certain prohibited areas were also maintained around the most recent outlying infected centres.

This Order was communicated to every Local Authority and Chief Constable, as well as to the Ministry's Officers and to the Press on Sunday night, 5th February.

The work thrown upon both the indoor and outdoor staff of the Ministry, and in many instances also upon the Local Authorities, by this outbreak has been exceptionally heavy, necessitating the addition of a large number of temporary Inspectors for stock inspections, the arranging and supervision of slaughtering operations, the sale of salvageable carcasses and the disinfection of infected premises.

Importation of Store Cattle.

IN reply to a question by Captain Fitzroy as to whether the Government had considered the Report of the Royal Commission on the embargo on Canadian cattle; and whether they proposed to make any alteration in the Diseases of Animals Act, 1894, Sir Arthur G. Boscawen (Minister of Agriculture) stated: "The Government have carefully considered the Report of the Royal Commission, but in view of the almost unanimous opinion of agriculturists of all classes in England and Wales that the removal of the embargo would seriously injure the industry, and of the fact that the Commission themselves report that it would have little effect on the price of meat, they do not propose to introduce legislation for the purpose of removing it."

In reply to supplementary questions, Sir A. G. Boscawen gave the following answers:—

"We have given consideration to opinion in Scotland, and there is very great diversity of opinion on this matter among agriculturists in Scotland."

"No Government is pledged to carry out all or any of the recommendations of a Royal Commission, which are the individual opinions of the Commissioners, and in this case even if we had accepted their conclusions they themselves say that they fully recognise that the opinion of Parliament may be a reason for some delay in taking action. Apart from that I

believe that in this matter certain pledges were given in 1917 at the Imperial Conference when this question, and a great many others, were under discussion, but, as I understand, the position which the Canadian Government most properly have always taken is that they do not wish to interfere in our home politics or home affairs, and that if we were convinced that the removing of the embargo was detrimental to our interests they would not press for it."

* * * * * *

Report on Acreage under Crops and Number of Live Stock in 1921.

FROM an agricultural point of view, the 4th June is a date of some interest as it is on this day that the agricultural returns of acreage and live stock have been collected annually for 56 years. Immediately the returns are complete the results for the whole of England and Wales are tabulated and issued—the results for last year being issued on 9th August. The Report now issued contains in addition to the totals for England and Wales the figures for the different counties, as well as the totals for Scotland and Ireland. Attention is drawn in the Report to the changes in the area of cultivated land and number of live stock in 1921, and some interesting figures are given showing the number of poultry on agricultural holdings over one acre in 1908, 1913 and 1921. Particulars are also given for the same years of the number of workers returned by the occupiers as employed on their holdings on 4th June.

This Report, which forms Part I of the Agricultural Statistics for 1921, can be obtained through any bookseller or directly from H.M. Stationery Office, Imperial House, Kingsway, W.C.2, and 28, Abingdon Street, S.W.1.

Conciliation Committees in Agriculture.

OF the 32 Conciliation Committee agreements in operation on the 22nd February, 8 are for periods up to and including the hay and corn harvest and it is clear that the advantages of long-term agreements are becoming more generally appreciated.

The hours question appears to be causing difficulty in some areas. The new agreements of the Shropshire and Isle of Ely Committees are especially interesting as indicating how this question has been satisfactorily settled in those areas. In the former area where agreement has been reached for a guaranteed week of 48 hours in February and 50 hours from March to Sep-

tember a condition of the agreement is that employers and workers agree to encourage the working of longer hours when necessary. In the case of the Isle of Ely, although the wages agreement operates only up to the 31st May next, it has at the same time been decided that the working week during the summer months shall consist of 51 hours, while for next winter the hours shall be 48 per week.

On the question of the weekly half-holiday there has been very little difficulty on the Committees, and in general it has been agreed that where the workers desire the half-holiday employers should facilitate the arrangement of the working hours accordingly.

Particulars of agreements relating to adult male workers, in force on the 20th January, have already been published. Further agreements reached up to 22nd February are shown in the following table :—

Area.	*Period.*	*Wages.*	*Hours per week.*
Cornwall - -	Up to 28th Feb., 1922	34/-	—
Derby - - -	" 31st March, "	36/-. Weekday overtime, 8d. per hour. Sunday employment, 11d. per hour.	54
Devon - - -	" 25th " "	34/-	50
" - - -	" 29th Sept. "	32/-	50
Dorset - - -	" 28th Feb. "	32/-. Carters, cowmen and Shepherds, 8d. per hour up to 60 hours. Over 60 hours, 10d. per hour.	48
" - - -	" 29th April, "	32/-. Carters, cowmen and shepherds, 7½d. per hour up to 60 hours. Over 60 hours, 9½d per hour.	51
Hertfordshire -	" 3rd March, "	8d. per hour. Guaranteed week of 48 hours.	—
Lancashire			
Southern area -	" 31st " "	45/-. Rates for other workers in proportion.	Customary hours.
Northern area -	" 31st " "	42/6	Customary hours.
Eastern area -	" 31st " "	50/-	Customary hours.

Area.	Period.	Wages.	Hours per week.
Middlesex S. -	Up to 2nd Sep., 1922	35/5. Guaranteed week of 48 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour. Carters, stockmen, &c., 8½d. per hour up to 60 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour.	50
Rutland - -	„ 28th Feb., „	32/-	48
	„ 28th Oct., „	32/-. Rates to vary 1/- for every change of 6 points in cost of living.	50
Shropshire - -	„ 6th March, „	8d. per hour. Guaranteed week of 48 hours. Sunday employment, 10d. per hour.	
„ - -	„ 30th Sep., „	7½d. per hour. Guaranteed week of 50 hours. Sunday employment, 10d. per hour.	
Somerset - -	„ 28th Feb., „	33/-	50
- -	„ 30th April, „	32/-	50
Stafford - -	„ 29th „ „	8d. per hour. Guaranteed week of 50 hours. Sunday employment, 10d. per hour.	—
Surrey* - -	„ 25th March, „ (Male workers from 21 to 65 years)	33/4. Overtime, 9d. per hour. Carters, cowmen and shepherds, and time worked between 50 and 60 hours per week, 8d. per hour, and all time worked by these classes in excess of 60 hours, 9d. per hour.	50
Sussex E. -	Up to 31st March, 1922	31/-. Overtime, 8d. per hour.	52
Warwick* - -	„ „ 3rd „ „	Able-bodied male workers, 31/-. Guaranteed week of 48 hours. Overtime, 8½d. per hour.	48
	„ „ 6th Oct., „	Able-bodied male workers 31/-. Guaranteed week of 50 hours. Overtime, 8d. per hour.	50

* Agreement confirmed by the Minister.

Area.	*Period.*	*Wages.*	*Hours per week.*
Warwick—*contd.*	Up to 6th Oct., 1922	14 to 15 years, 33⅓ % of wages fixed for men of 21 and over.	
		15 „ 16 „ 40 „ „ „ „	
		16 „ 17 „ 50 „ „ „ „	
		17 „ 18 „ 60 „ „ „ „	
		18 „ 19 „ 70 „ „ „ „	
		19 „ 20 „ 80 „ „ „ „	
		20 „ 21 „ 90 „ „ „ „	
Merioneth and Montgomery -	„ „ 28th Feb., „	35/- or 38/-	50 56

The Isle of Ely Committee have arrived at an agreement for wages from 1st March (when their existing agreement expires) up to 31st May, which, in accordance with the Committee's application, has been confirmed by the Minister. Th agreement provides as follows:—

(*a*) Male Workers aged 18 and over, employed as Horsemen or Milkmen:—

Years of Age and Wages.		
21 and over	40/6	For a week comprising the hours necessary for the performance of the customary duties of these classes of workers.
20 and under 21	37/9	
19 „ „ 20	35/6	
18 „ „ 19	34/3	

(*b*) All other male workers employed in agriculture:—

Years of Age	*Weekly Wages for a week of 51 hours.*		*Overtime rates for all time in excess of 51 hours per week.*
21 and over	31/-	...	8½d.
20 and under 21	28/9	...	8d.
19 „ „ 20	27/-	...	7½d.
18 „ „ 19	25/9	...	7d.
17 „ „ 18	20/6	...	5½d.
16 „ „ 17	16/3	...	5d.
15 „ „ 16	13/3	...	4½d.
14 „ „ 15	10/3	...	3d.
Under 14	7/3	...	2½d.

That the working week for summer months (*i.e.*, from the first Monday in March to the last Saturday in October) shall consist of 51 hours, and for next winter (*i.e.*, for the period other than the summer months) shall consist of 48 hours.

While no definite agreement is made regarding Saturday half-day, the employers will not put any obstacles in the way of farmers arranging with their workmen for a Saturday half-day after 51 hours have been worked, and this clause is to be carried out in a reasonable spirit.

Further details of the agreements in each area can be obtained on application to the Ministry.

* * * * * *

The Agricultural Index Number.

PRICES during January were on the average again slightly lower than in the previous month, being only about 79 per cent. above the pre-War level as compared with 82 per cent. in December. The following table traces the course of prices of agricultural produce monthly from the beginning of 1919 down

to the present time, the figures representing the percentage increases in value as compared with the average of the three years 1911-13:—

Month.	1919. *Per cent.*	1920. *Per cent.*	1921. *Per cent.*	1922. *Per cent.*
January	148	213	186	79
February	150	205	172	—
March	150	199	158	—
April	153	199	141	—
May	132	169	112	—
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September	148	181	105	—
October	166	191	90	—
November	182	197	84	—
December	207	194	82	—

Wheat and oats were practically unchanged in value in January as compared with December, 1921, but barley was again cheaper, averaging about 50 per cent. above the pre-War price. Fat and store cattle were somewhat cheaper, and dairy cows decidedly so, averaging about £39 per head or about 89 per cent. above the 1911-13 price compared with £42 and 104 per cent. in the previous month; dairy cows, however, remain the dearest class of stock in comparison with pre-War days. Fat and store sheep appreciated in value, a steady rise continuing throughout the month, while store pigs were also dearer, although fat pigs showed little change. Eggs again experienced a sharp decline in price, which was, however, recovered to some extent during the latter part of the month. Dairy produce generally sold at lower rates, butter especially falling in price, due probably to the recent substantial reductions in the price of imported butter. The average price of milk delivered under contract into large towns was in January about 157 per cent. above the annual price, and roughly double the average winter price in pre-War days. Hay showed little alteration, while potatoes met a rather better trade at firmer values.

Among the commodities purchased by the farmer, the chief reductions have been in milling offals and in the phosphatic manures. Other feeding stuffs are also generally cheaper, linseed cake exceptionally showing a slight rise. A slight fall in the price of nitrate of soda was off-set by a corresponding increase in the cost of sulphate of ammonia.

Imperial Fruit Show, 1922.

AT this period of the year Fruit Show Committees are generally meeting to make arrangements for the holding of Fruit Shows throughout the country. All fruit shows where the best of fruit is exhibited packed in an approved manner, are naturally of an educative kind, but the education can be directed to appeal to different classes of people. It may be directed towards affording stimulation and information for the producers or it may be intended to arouse the interest of the consumers.

There is certainly a need for both types of show, for no one would say that the systems adopted by the producers of fruit in this country are of a sufficiently high standard to admit of no improvement, while the arguments for the education of the consumer are possibly even greater, since at the present time large numbers of people in this country know but little of fruit and are unaware of its dietetic value. Wider knowledge of the facts would increase their interest and stimulate the demand for good varieties of fruit. Shows held in the producing areas are of great interest to the local growers, and certainly meet the first point. In past years the fruit shows organised by The West Midland Counties Commercial Fruit Show Association, The Eastern Counties Commercial Fruit Show Association, and The Kent Commercial Fruit Show Association have had a very beneficial effect amongst the fruit growers in the respective areas, and there is a distinct need for the growers in other areas, such as the West of England, to follow their example in this direction. These local shows are organised by the growers themselves, and the cost involved is but small.

The growers, however, cannot afford to leave matters at that point, because they depend on the sale of their commodities, and it is to their financial interest to stimulate a demand for these commodities amongst the consuming population of the country. For this reason they should follow the example of the motor and other industries, and arrange for shows in the large centres of population such as London, Birmingham, Manchester, Leeds, Liverpool. In order to attract the public these shows must be organised on an extensive scale and be backed by extensive advertising and propaganda. The cost involved in organising shows of this kind is out of all proportion to the cost of the local shows, but they are vitally necessary, and the financial support might be forthcoming by the friendly co-operation of all the Federations of the Associations within the horticultural industry. Co-operation at all times is difficult, and at present the Federations are not prepared to bear the financial responsibility.

The Directors of *The Daily Mail*, however, offered to organise and be financially responsible for another Imperial Fruit Show to be held next autumn, similar to that which was held in 1921, but slightly modified in character, provided always that the bulk of the industry pledges its support and co-operation. The Ministry and the industry, by means of an Advisory Committee, which will be representative of the various sections of the industry of this country and of other parts of the Empire, will co-operate with *The Daily Mail*, to which all matters of finance and general organisation will be left. Decisions on technical matters, including the drawing up of the Regulations, the Classes and the selection of Judges will be in the hands of the Committee. This should be a sufficient indication that the interests of the industry are safe-guarded. The great point for the industry to realise is that such shows will greatly aid the industry, by educating the grower and increasing the demand for fruit, and by stimulating the consumers' interest as to the dietary importance of fruit and its by-products.

The proposed show will have classes affording competition between home producers and those from overseas, and should not be to the disadvantage of the home industry. The overseas grower, to overcome the handicap of distance from his market, has been compelled to adopt systems of grading and packing of fruit in advance of those generally adopted by the home industry, and study of their methods is of considerable advantage to the home producers. This friendly competition with the peoples of other parts of the British Empire should be welcomed by the home industry.

In the organisation of a big show which is both National and Imperial, and where sections of the industry are co-operating that normally have competing interests, it is naturally an important and a difficult matter to secure agreement. Fruit growers may, however, be assured that the composition of the Advisory Committee suggests there is no likelihood of any important matter being decided in a manner detrimental to their interests.

The offer of *The Daily Mail* to organise and finance the show, in co-operation with the Ministry and the Advisory Committee, is now under the consideration of the fruit-growing industry, and the Ministry asks fruit growers, and all others interested in fruit, to give their support to the undertaking for the good of the whole industry.

YOUNG FARMERS' CLUBS.

F. E. BUSSY,
Director, Associated Newspapers, Ltd.

INCREASED interest is being taken by both agriculturists and the general public in the Young Farmers' Club movement, which is being vigorously promoted by *The Daily Mail* and several big industrial concerns in the country.

It is the purpose of this article briefly to explain what the Young Farmers' Club is and does, and the results which have been attained in England and also in the United States of America, from which country the movement hails.

Given some public-spirited local resident who will bear the very small financial burden which the establishment of a Club imposes, and two or three energetic helpers (who will act in the capacity of Advisory Committee), the formation of a Club is a very easy matter. Having decided what kind of stock or produce can most advantageously be raised, having regard to local conditions, the following is the line of action taken:—

The Advisory Committee call together the children and parents in the district where the Club is to be formed (and it is desirable that the children should not be drawn from a very wide area), and outline the scheme to them. Having interested from ten to twenty children, ranging between 10 and 18 years, as Club members, they are instructed to appoint their own officers, *i.e.*, Chairman, Vice-Chairman, Secretary and Treasurer. The duties of these officers are explained to them by the Advisory Committee, and from this point the Club is left to conduct its own business and carry on its own meetings.

Associate members, for whom there is no age limit, are elected on passing ballot of the Club members. This entitles them to attend lectures and take part in discussions, but gives them no power to vote or enter for competitions. Associate members pay a subscription determined by the Club members. In practice, it usually happens that parents desire to become associate members, and the Club funds benefit accordingly.

The children meet once weekly or fortnightly, and are given a lecture or hold a discussion on the particular project in which they are interested. Lecturers can readily be obtained for this purpose. The Ministry of Agriculture has promised that its local officers and those of Agricultural Universities and Colleges will be available for giving such lectures, while the most

prominent professional stock-raisers readily respond to the invitations of Clubs to lecture.

In almost every district where any particular kind of stock or crop is raised, there are local Associations whose leading members are willing to give instruction.

On occasions when no lecturer is available the children read and discuss a chapter from one of the standard agricultural or horticultural books. Numerous pamphlets and bulletins are obtainable from the bodies before mentioned, and from the Colleges.

When the preliminary instructions have been given the children are called together and ballot for the animals they are to keep. These animals, which are purchased by the founder of the Club, are scored on points before they are handed over to their youthful custodians, and a note of hand, bearing no interest, and signed by the parent, is taken in exchange.

At the end of a period, which will be determined according to the nature of the stock (in most cases it is one year), and during which the Advisory Committee will pay periodical visits to the children's homes to see that the animals are properly looked after, and to withdraw those which are not, the stock will be brought together and re-judged on points. Small prizes will then be awarded to the children whose animals have made the greatest progress while in their care, and other small prizes for the best stock records, showing actual cost of feed and labour, and weight of feed given to animals, etc., that the children have kept in specially prepared books.

The animals are then put up for auction and sold. Ten per cent. of the price realised is paid into the funds of the Club, the value of the animal at the date it was handed to the child is returned to the founder of the Club, and the balance is handed to the child as compensation for feeding and a reward for industry. The child can buy in the animal if so desired, by paying the original value, plus the 10 per cent. which goes to the Club Fund.

From this it will be seen that the only expense which falls upon the founder of the Club is the small sum involved in the prize money (which should never exceed £20), and the interest on the capital value of the stock for twelve months. The scheme varies as to detail according to the nature of the stock or crop to be raised.

The foregoing is the general outline which should be applicable to practically all *stock*-raising Clubs.

With crops the arrangement must vary slightly. Either the donor of the Club is asked to provide a plot of land and the necessary fruit trees, to take by way of rental the sum of 3s. a year (for about a 4-perch allotment) from the child, or the children use a measured plot of ground on their own farms or gardens. Prizes are awarded for the best cultivated plots and for the best kept records, showing cost of fertilizers, etc., and the best kept tools. All surplus produce raised on the plot is marketed through the Club, who credit the member responsible with the value, less 10 per cent. contribution to the Club fund. At the prize distribution at the end of the season, the net proceeds are returned to the members.

The founder of the Club provides all the necessary tools against a note of hand for their value from the parent, and the repayment of the cost of tools becomes a first charge on the sale of produce. In some cases it is possible to allow members to carry on the Club work in their own gardens. When this is done the gardens are handicapped according to their size and degree of cultivation at the start of the contest. Where young fruit orchards are planted for the purposes of a Club, the children are instructed in inter-cropping vegetables while the trees are coming to maturity. Alternatively, when the person who is promoting a Club does not himself rear or raise the stock to be issued to the children, does not want to buy it, and (or) is not prepared to advance the necessary capital free of interest,—then the advance is made to the Club direct by the promoter at an agreed rate of interest, and the Club holds the notes of hand from the children's parents. In such a case repayment of capital and interest is made a first charge upon the sale of produce or stock. The Advisory Committee, with the assistance of the local Divisional Inspector, supervises the purchase of the stock most suitable to the locality.

Such is an outline of the formation and working of the Clubs. Their advantages are obvious.

They bring the agricultural college to the door of the youngsters by means of lectures and demonstrations, and enable them to put into practice the facts obtained from scientific books, and the bulletins of the world's leading agricultural colleges.

Scientific research is continuously going on in agriculture, and the Young Farmers' Club enables the rising generation of agriculturists to take immediate advantage of laboratory discoveries by their practical application.

All the time the Club is dignifying the farmer's vocation,

by demonstrating to the young people that labour intelligently applied to farming brings satisfactory returns.

The fact that the Club members conduct all their own Club business on their own initiative, instructs them in the proper conduct of public business, and prepares them for leadership in public life. It encourages them to speak in public, and this develops self-reliance and self-confidence.

Morally, the scheme achieves even more. It is often complained that boys and girls in rural communities have no outlet for their boundless mental and physical energy. The Young Farmers' Club gives them a fascinating and inspiring occupation, and provides them with a definite purpose at an important period of their lives. They are drawn together by the Club, and thus isolation is diminished, and budding talent for leadership is developed. The " mute inglorious Miltons " are taught to express themselves, and their eyes are drawn to a wider horizon of endeavour and achievement.

Love of home and country, and loyalty and respect for constituted authority are first-fruits of the teaching of the Clubs, and they assist in the development of a fine spirit of co-operation in the community.

In America the movement has reached tremendous proportions. Of students taking the regular course in agriculture and home economics in the State Colleges in 1920 over 1,800 were boys and girls who had been members of the Clubs, while over 3,300 club boys and girls took short courses at the colleges, 730 having won scholarships through their club work.

One of the great merits of the movement as manifested in America is that it is splendidly resultful as propaganda for pure-bred stock. It is a matter of actual record that during 1920 5,000 farmers were led to replace poor-bred pigs with pure-breds as a result of the pig club work of the clubs.

In 1920, 3,000 poultry-club members in the Northern and Western States introduced 38,000 pure-bred fowls on their home farms and raised 155,000 chickens.

In the same year there were over 216,000 American boys and girls between the ages of 10 and 18 years engaged in the work of 14,000 clubs. The actual financial output for the year was over $4,600,000, which is eloquent evidence of the sound business basis of the movement.

In the Northern and Western States of America the club work is recognised as of such importance that 200 counties employ county club agents to co-operate with districts in

developing demonstration work. In such counties annual appropriations of from $3,000 to $4,000 are made to carry on the work.

In England the movement is, of course, in its infancy, but it shows signs of lusty growth. There are existing and in course of formation over a score of Young Farmers' Clubs in England.

The Daily Mail is responsible for Poultry, Bee, Dual-purpose Rabbit, and Horticultural Clubs at Welwyn Garden City. These have been in existence for periods ranging from 12 months in the case of the Bee Club to a month in the case of the Horticultural Club.

The United Dairies, Ltd., are the sponsors of Calf Clubs at Hemyock, Devon; Kingsclere, Berkshire; and Loughborough, Derbyshire; the oldest club being the Hemyock Calf Club which has just celebrated its first birthday.

Messrs. C. & T. Harris, of Calne, Wilts, have organised a Pig Club at Wootton Bassett, Wilts, and Mr. R. G. Heaton, a well-known stock breeder, is the patron of another Pig Club at Northaw, Potters Bar, Herts. At Northaw a Poultry Club is in process of formation under the guidance of Mr. Tucker.

Ten clubs dealing with a variety of stock and produce are in course of preliminary organisation amongst the children of employees of a large industrial firm in the North of England and North Wales.

THE NATIONAL INSTITUTE OF AGRICULTURAL BOTANY.

W. H. PARKER, M.C., M.A.,
Director of the National Institute of Agricultural Botany.

IN several of the recent issues of this *Journal* passing reference has been made to the National Institute of Agricultural Botany. It is now proposed to give a full description of its organisation and functions, for its headquarters are completed and opened, it has already been accorded the honour of a visit from Their Majesties the King and Queen and Princess Mary, and the work for which it was founded is now going forward.

Inception of the Institute.—England may always feel proud that, through the agency of Sir John Lawes and Sir Joseph Gilbert, it was she who took the initial step in agricultural

research. Rothamsted has been the model on which all similar research stations throughout the world have based their constitutions, and has never lost the lead which these two great men afforded it in the investigation of problems connected with the soil and its manuring. Thus it is only just that this country should now be able to recover from abroad a portion of the debt thus created.

England had long been satisfied to rely on her acknowledged lead in soil and manurial science to maintain her position as the producer of the highest yields per acre of any country in the world. Naturally a degree of improvement had gradually taken place in the productivity of the crops themselves, but until a comparatively recent date work on these lines was left entirely to the competitive efforts of the seed-trade or the more or less chance discoveries of amateurs. New varieties were thrown on to the market to sink or swim as fortune dictated—it could not be otherwise, for yield testing is even now in its infancy. Yet at this early stage the one definite fact emerges that only trials carried out on a scale beyond the capacity of any private undertaking can produce results on which reliance can be placed. The value of varieties was necessarily determined by purchasers who established, by the costly system of trial and error, what was, and what was not, worth retaining in cultivation.

Such, in fact, was the position in England when the Great War broke out. With the War came the realisation that the life of the nation depended on its crops, and that every possible method of increasing the food production of the country must be exploited if it were to survive the ordeal.

Objects and Policy.—Sir Lawrence Weaver, then in the Food Production Department of the Ministry of Agriculture, thought that the most hopeful line of attack on this problem was to concentrate on the improvement of the national seed supply. Not only did he contemplate insuring an adequate supply of pure healthy seed, but he wished to provide a stimulus which should induce increased production and rapid distribution of improved varieties of our agricultural plants, so that the land should be used to the greatest possible advantage. The result was his scheme for a National Institute of Agricultural Botany.

With such an aim in view it is natural that he should turn for guidance to that great Swedish station—Svalöf—where work of this kind had been in progress since 1886. The conditions were not parallel, but the line of intersection lay some

distance along the path on which it seemed that the new Institute should travel.

The Swedish Society for the Improvement of Seeds had come into existence at a time when elsewhere no attempt whatever was being made towards crop improvement; its aims were proprietary, for it was constituted solely with a view to supplying its own members with superior strains of farm crops which it proposed to obtain by methods of selection. It existed for production rather than distribution, and when, later, distribution was introduced as a new development, the Company which was formed for this purpose worked primarily for the benefit of its shareholders, and, in effect, swamped any competition likely to prejudice its prosperity.

The functions of the National Institute of Agricultural Botany were designed with quite a different object. It was emphatically "National," and it set out to encourage every effort towards plant improvement, no matter from what source that effort originated; only itself embarking on such undertakings as would assist others, whether seedsmen, scientists or farmers, to advance in the direction of improved output, ensuring to the fruits of such endeavours a more speedy and profitable recognition and use. Its very constitution is proof of its catholicity, for members of the Council are nominated by the following bodies:—The Ministry of Agriculture, Cambrige University, Oxford University, The Agricultural Seed Trade Association, The National Association of Corn and Agricultural Merchants, The National Association of British and Irish Millers, The Royal Agricultural Society of England, The National Farmers' Union, with the addition of members to be nominated by the Fellows, concerning whom more will be said at the end of this article.

From the first it was obvious that plant-breeding was outside the Institute's functions, for the rediscovery of Mendel's papers had already given an unprecedented impetus to this essential foundation of the success of the undertaking, turning it from a game of chance into a science. What was now required was an outlet from the research station to the market, but designed in such a manner that egress would only be conceded to productions of proved merit. Thus, in relation to new varieties, the Institute took as its basic principles "test" and "multiplication," at the same time making provision for a reasonable profit to the producer, who hitherto had been the smallest participant in the fruits of his effort.

FIG. 1. The National Institute of Agricultural Botany.

FIG. 2.—Room for Examination of Seeds for Purity.

As the scheme developed its basis broadened. The Ministry of Agriculture proposed that since this new Institute existed with the object of seed improvement, all seed problems, including potato " seed," should come within its scope. To it was, therefore, handed over the administration of the Official Seed Testing Station, which had recently been set up in the Food Production Department. It was further arranged that the Institute should be entrusted with the growing of the potatoes entered for the annual trials for immunity to Wart Disease, the Ministry retaining the responsibility for pronouncement of immunity and the certification of varieties. Owing to this delegation of functions the Institute became a semi-official body.

Finance.—*Capital.*—That there was a demand for such an undertaking is evident from the nature of the response which resulted from the founder's appeal for funds with which to give shape to the conception. With the assistance of his fellow members on the Council £44,870 was soon accumulated, including the value of the gift by Mr. Fred Hiam of a 344 acre farm (since re-named " The Hiam Farm ") near St. Ives, Huntingdonshire. Of this sum no less than £23,350 was derived from the Seed Trade and the Farming Industry. The whole of this amount was earmarked for the Institute's Capital Fund.

The Development Commission was approached in 1916 with a view to obtaining a grant for building the Official Seed Testing Station and a loan for the other activities of the Institute. Its final recommendations to the Treasury were accepted in November, 1919, and a grant of £25,350 and loans amounting to £21,568, making a total of £46,918, were sanctioned.

Maintenance.—Sanction was also given to the principle of an annual grant equivalent to two-thirds of approved expenditure on salaries, upkeep, etc., until such time as the Institute's sale of its products shall have put it on a self-supporting basis. The remaining third has to be made up by private subscriptions.

The Testing of Seeds being a public service, the whole cost of maintenance of the Official Seed Testing Station is borne on the Ministry's Vote, and is met out of public funds.

For the Institute's work in connection with the Potato Immunity Trials, the Ministry provides two-thirds of the salaries of the Superintendent of the Station and of his assistant, and £100 for each acre occupied by the Immunity Trials, in addition to the repayment of certain other items of expenditure. The remainder of the cost of operating the Station falls on the general funds of the Institute.

Staff.—The difference in financial treatment outlined above marks out the three Branches into which the Institute is divided. At the head of the whole undertaking (under the Council) is the Director who has as his immediate assistants the Secretary and the Accountant. The Branches are as follows:—

(1) The Crop Improvement Branch, under the personal charge of the Director.

(2) The Official Seed Testing Station, under Mr. C. B. Saunders, as Chief Officer.

(3) The Potato Testing Station at Ormskirk, Lancs., under Mr. H. Bryan, Superintendent of Potato Trials.

The staff of the Institute (apart from farm labour) in the three branches consists, in all, of 55 persons.

The work of each of the above branches is carried on under the general supervision of a Committee of the Council composed of experts in the several directions in which each has its sphere of activity. The activities of the several branches are described below.

Property in Land.—The properties of the Institute are as follows:—

The Headquarters Trial Ground, consisting of 36 acres of arable land on the Huntingdon Road, Cambridge, on a portion of which the Headquarters Buildings have been erected.

The Hiam Farm, St. Ives, mentioned above, which has been enlarged by the purchase of a further 20 acres, making 354 acres in all, which will be devoted principally to the growing on of cereals for seed.

The Potato Testing Station, Ormskirk, Lancashire, consisting of a farm-house, an office, and 39 acres of rich market-garden land.

The Headquarters Buildings.—The decision of the Council that the Headquarters of the Institute should be established at Cambridge was based on two considerations, (1) that a situation in the centre of an agricultural district was essential, and (2) that the locality should be one in which agricultural research, and particularly plant-breeding, was already thriving. Cambridge was the obvious place, and a site was purchased ideally situated immediately opposite the University Farm, and within a quarter of a mile of the farm occupied by Professor Biffen's Plant Breeding Institute.

The planning of the buildings was entrusted to Mr. P. Morley Horder, and two Committees—the first accompanied by the Architect—visited Svalöf, and all the more important Continental Seed Testing Stations before the final plans were drawn up. The need for economy precluded anything but the plainest design, and all ornamental features were rigidly

excluded. At the same time no trouble was spared which would make for working efficiency, and the result has been the provision of the best-found Station at present in existence.

As it stands, it is a two-storied building with a hipped mansard roof which allows space for an attic floor. It is constructed of local brick of varied shades, and consists of a central block, flanked on either side by projecting wings, forming an open court.

It is of interest to note that the whole of the main block is devoted to Seed Testing. On the ground floor, facing south, are the offices of the Seed Testing Station, in one of which samples are received, and from the other, reports of the tests are sent out. The office of the Chief Officer is centrally situated on the first floor, and the office above, on the attic floor, is occupied by the Principal Seed Analyst. The work of the Station is divided among four Sections—Vegetables and Cereals on the ground floor with Grasses and Clovers above. Each Section has its large laboratory for purity examinations, a room for the Head of Section (with a window looking into the purity room), and a smaller laboratory fitted with incubators in which germination tests are made. There is an additional clover germination room on the first floor, and the large laboratory on the attic floor is fitted with incubators of a special type—Copenhagen tanks—used principally for germination tests of the seeds of smaller grasses; also on the attic floor are the research laboratory, studio, dark-room, and store-room.

The ground floor of the west wing contains the offices of the Director, Secretary and Accountant of the Institute, and is therefore the centre of all the Institute's activities. From here also the work of the Crop Improvement Branch is controlled. On the first floor of this wing is the Council Room, the walls of which consist of panelled presses in cypress which already contain the nucleus of a reference library of books and pamphlets on subjects relating to the work of the Institute. The upper panels are gradually being replaced by portraits of Members of the Council and benefactors of the Institute.

On the first floor also are the Librarian's Room, Committee Room and office of the Manager of Field Plots.

The west wing consists of a Staff dining-room and kitchens on the ground floor with flats for members of the staff above.

A small existing farmhouse is occupied by the Secretary of the Institute. The adjacent farm buildings, and the remainder of the

Headquarter Trial Ground (some 30 acres) are to be devoted to the work of the Crop Improvement Branch. At a later date it is proposed to erect a seed-cleaning plant near the farm buildings.

The Crop Improvement Branch.—The future scope of this portion of the Institute's work is only limited by the question of finance. Among the diverse problems which come within its legitimate scope the following are the most outstanding:—Yield trials; quality tests; the introduction of new varieties and species; the study of varieties and strains with a view to the supplying of stocks suitable for the various conditions of soil and climate of the country, and by this means, possibly, the provision of material rendering a profitable return for the growing of crops hitherto considered unsuited to specific districts; the study of problems of seed-growing and retention of purity of stocks; seed-storage problems; the testing of varieties and strains for resistance to disease and insect attack; synonymity and other questions. At present it has only been found possible to begin work on the more pressing of these matters.

To perform its functions it is essential that the Institute shall only assist in the distribution of varieties which have proved their superiority in some desirable characteristic over those already in cultivation. Not only does this hold good in the case of varieties distributed through the Institute, but encouragement will also be given to worthy productions from other sources. At the present time, high yielding capacity is of paramount importance, and, for this reason the Institute is devoting much of its attention to yield testing on a field scale, cereals being the first group to be dealt with. To obtain results of more than local value the Institute is endeavouring to establish relations with institutions or individuals in the principal agricultural districts with a view to their co-operation in the conduct of field-trials, on a fixed plan, of the crops of special interest to their own areas. Varieties are to undergo a three years' trial, the first year on one of the Institute's properties in order to eliminate the effects of previous cultivation and climatic conditions, the two succeeding years ("full trials") simultaneously at several stations. Varieties of established merit serve as standards, and a new system of alternating strips of standard and new varieties, which has been proved to give unprecedented accuracy of result, is employed throughout. The trials are open to all who undertake to withhold their entries from the market until after the publication of the results of the third year of the trials, and who agree to defray their quota of the costs. Stocks are only eligible on

evidence that they are genuine novelties obtained by hybridisation or selection, and that there is reason to anticipate that they are superior to those already in cultivation.

Series of barleys and winter oats have already reached the "Full trial" stage, and it is anticipated that wheat and spring oats will be dealt with in the coming season.

Under specified conditions the Institute will undertake to distribute stocks which have proved their value in these trials, sharing profits with the producers. It has already the option on all productions of Professor Biffen's Plant Breeding Institute. and there is reason to believe that many other institutions and individuals will avail themselves of the facilities offered. The proposed seed-cleaning plant will be required to deal with these stocks, and plans have already been prepared.

Apart from this work, collections are being made of (1) Plants from abroad which might be of value under English conditions; (2) Old varieties in danger of extinction; (3) Reference collections of established modern varieties. Plants other than cereals are included in these collections. In view of the trend of present agricultural conditions, the investigation of forage crops will not be ignored.

The Official Seed Testing Station.—Seed testing is considered by those lacking technical knowledge to be a simple process, little do they realise the fine points involved even in the routine work of a Station which undertakes to issue reliable reports on samples of any kind of seeds which it may please the public to submit for test. The technique of testing requires constant revision, and, this must always be the case, for the methods of testing are necessarily arbitrary owing to the impossibility of even an approximation to the conditions for which the test is intended to furnish information. The farmer knows by experience the correct sowing time for the production of the most favourable results; the Station's tests must be completed and the reports sent out some time before this date. Thus, what would otherwise be the rational method of testing—in small field plots—is precluded. Indoor testing is the necessary alternative, for only thus can temperature, "seed-bed" and water supply be controlled: but what control should be exercised? Even a cursory study of the extremes of soil, climate and rainfall to be found even in England and Wales shows how impossible it is to devise a test which will represent "natural

conditions." The ideal is to supply to each seed the best possible opportunity for germination; for it is found that the higher the germination under the best conditions, the better the result under those of the field. Seeds, however, are capricious, and although it is easy to adopt the best possible conditions as a standard, each species, and, in many cases, each variety has its own special requirements which must be satisfied before it will put forth its best endeavours; and each necessitates separate study.

Quite apart from the routine work, there are, in addition, innumerable other problems which demand attention—such as the identification of diseases; the determination of the value of "hard seed" in clover; the survival value of split seed; the determination by prevalent weed seeds of place of origin of samples; the value of rapid germination as an indication of vigour; the identification of Crucifers—and many more. Enough has, however, been said to show that the testing of seeds is a highly technical subject, worthy of the position which it holds in the work of the Institute.

The Station, from 1st August, 1920, to 31st July, 1921, issued reports on the following samples:—

Grasses	3,238
Clovers	5,198
Vegetables, Roots, etc.	6,946
Cereals and Pulses	8,044
Forest Trees	151
	23,577

As far as can be judged, an increase of 6 per cent. on these figures is to be anticipated in the present year.

The Potato Testing Station.—The control of a disease for which there is no known cure is a problem which requires very special measures. If, in addition, the spores of that disease can establish themselves in a locality and survive for years without visible means of subsistence, ready at any moment to attack those susceptible to their onslaughts; and if these spores can be carried from place to place by agents having no relation to their chosen hosts, the difficulties would appear well nigh insuperable. All this is true of wart disease of potatoes, yet, in spite of it, healthy and remunerative crops are being grown in the infected areas.

Immunity Trials.—Almost from the time that this scourge first received serious attention in England, it was noticed that certain varieties were immune from its onslaughts. Mr. John Snell, an Inspector of the Ministry of Agriculture, appreciated the latent possibilities of this discovery, and, while stationed at Ormskirk established, with purely local support, the Immunity Trials which are now world-famed. Before his death in 1920 the Ministry had recognised the value of the work and was providing the necessary funds. The trials had, however, outgrown the famous Workhouse Ground, and were transferred to the 40-acre farm acquired by the Institute, where in 1922 they consisted of 778 stocks, occupying $3\frac{1}{2}$ acres divided into small plots.

After Snell's death his original supporters, the Ormskirk Potato Society, raised a fund for the perpetuation of his memory; the memorial took the form of a portrait which now hangs in the Potato Testing Station, and a medal, to be awarded annually to persons whose work shall have helped to improve potato husbandry either by scientific, administrative or commercial means. The responsibility for the award of this medal has been delegated to the Institute, and the first medal was awarded in December last to Mr. Ezra Miles, well known for his breeding work.

New Varieties.—In addition to the conduct of the Immunity Trials, the Institute is performing another service of which Snell was the originator. Annually from 1913 till his death, a report was published giving his considered opinion as to the right to be considered as novelties of so-called new varieties sent to the Station for Immunity Test. An Annual Report is now compiled by a Committee appointed by the Institute—the Potato Synonym Committee under the chairmanship of Dr. Salaman—composed of some of the greatest experts, who investigate every plot grown at the Station and record their decisions. The Report, before publication, is submitted to a Conference composed of leading potato raisers and merchants, scientific and official members, for discussion and approval.

Maturity Trials.—In 1921 Potato Maturity Trials were started at Ormskirk with the object of establishing the time of ripening of different varieties, and also of gaining information as to the correct method of attacking the problem of yield testing, which, with potatoes, presents such exceptional difficulties. No conclusion can yet be published, but the work is progressing satisfactorily.

All the Institute's potato work, including that of testing and multiplication of new varieties, is controlled by the Potato Committee. The Council of the Institute have recently approved a scheme recommended by this Committee by which novelties may be taken over from breeders at an early stage, tested for yield and quality (on land in Scotland lent to the Institute for that purpose) and multiplied for distribution through the trade; the proceeds to be shared by the breeder and the Institute. Already offers of new varieties to the limit of the Institute's capacity have been received, and the work will be started during the coming season.

The whole of the executive work connected with potatoes is under the immediate control of Mr. H. Bryan, who has lately been transferred from the Ministry of Agriculture for this purpose.

Fellowship.—As has been explained on p. 1075 under "Finance," such was the success of the initial appeal for funds, that it has been possible, with the assistance of the Development Fund, to erect the Headquarters and organise the work for which the Institute was founded. It is now essential that funds shall be forthcoming to secure to it an assured annual income sufficient to enable it to maintain its present activities and to embark on further projects designed with a view to the improvement of crops. With this as its aim, the Council has initiated a Fellowship of the Institute, which, it is hoped, will meet with wide support from all those who have at heart the success of British farming.

The Fellows have a right to elect as members of the Council one of their number for each five hundred (or part of five hundred) Fellows up to a maximum of four. Fellows will be kept in touch with the work of the Institute by means of meetings at which papers will be read, and by the Institute's publications. The Council, however, do not base their appeal on the anticipation of personal advantage as an incentive to Fellowship, but rely on an altruistic appreciation of the strength which will be given to the Institute by the subscriptions, and, still more, by the continuing interest of a large and representative body such as is hoped will come forward to be enrolled.

The fees payable by Fellows are as follows:—

£1 1s. Annual.

£7 7s. Composition for 10 years.

£15 15s. Composition for Life.

From a financial point of view it must be pointed out that every guinea forthcoming from private sources has a potential value of three guineas towards the income of the Institute.

Although the Fellowship has only recently been started, the support so far forthcoming encourages the belief that when the scope of the work which the Institute is undertaking is appreciated, the hope of the Council that two thousand Fellows will be enrolled will speedily materialise. Among those already elected are His Royal Highness The Duke of York, K.G., President of the Royal Agricultural Society, The Duke of Bedford, The Marquess of Crewe, The Earl of Ancaster, The Earl of Derby, The Earl of Crawford and Balcarres, Viscount Milner, Lord Ailwyn, Lord Clinton, Lord Bledisloe, Lord Ernle, Sir Gilbert Greenall, Sir Harry Verney, Sir Matthew Wallace, The Hon. E. G. Strutt, The Rt. Hon. E. G. Pretyman, M.P., The Rt. Hon. Walter Runciman, Lieut.-Col. The Rt. Hon. Sir Arthur G. Boscawen, Sir Thomas Middleton, Mr. Charles Adeane, Mr. Samuel Farmer, Mr. R. R. Robbins, and Lady Margaret Boscawen.

The Prime Minister, the Institute's first Life Fellow, has written to the Chairman as follows:—

10, Downing Street,
Whitehall, S.W.1,
3rd November, 1921.

Dear Sir Lawrence,

I have been following with great interest the rapid progress of the National Institute of Agricultural Botany, and congratulate you and your colleagues on the serious and useful work the Institute is already doing for the farming community. You are wise to broaden the basis of your organisation by creating a Fellowship of the Institute, which will enable everyone concerned with the improvement of crops to help forward the good work.

I gladly show my appreciation of what you are doing by asking to be enrolled as one of the first Life Fellows of the Institute.

With all good wishes for its continued progress both in successful work and in wide support from everyone interested in agriculture,

Believe me,
Yours sincerely,
(Sgd.) D. LLOYD GEORGE.

It is obvious that this letter has been, and will be, considered worthy of the most serious attention of that growing number of persons who realise that the future prosperity of agriculture in the British Isles is widely dependent on what the Royal Agricultural Society of England retains as its motto—"Practice with Science," and more narrowly on the Institute's motto of "Better Seeds; Better Crops." A copy of the second report of the Council and particulars of the Fellowship can be obtained on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

PLOUGHING AND PLOUGHING MATCHES.

H. G. RICHARDSON, M.A., B.Sc., and G. E. FUSSELL.

Ministry of Agriculture.

THE opinion is current that ploughing matches are one of those time-honoured institutions of thé countryside which are smitten with decay. The farmer and the landowner, it is thought, do not encourage the men, and the men who take a pride in their work are a dying race and are not eager to compete in such matches. From figures which will be quoted later it can be definitely shown that, certainly in many parts of the country, this is far from the truth, although in some districts ploughing matches may have died with little immediate prospect of resuscitation. It is hardly necessary to refer to the obvious fact that changes in the system of agriculture cannot fail to affect all competitions of technical skill; ploughing matches may give way to cheese-making and milking competitions, or they may conceivably one day disappear because they no longer have any vital bearing on the daily task, because personal skill and personal pride are

centred around other things than driving a furrow straight and setting it up and showing off a fine team. Nevertheless, so long as the spirit lives which underlies all matching of skill with skill or pride with pride, there will be a transformation only, the spirit will clothe itself in a new guise. Not a little may be learnt from the story of the rise and progress of ploughing matches, and of the days before ploughing matches were inaugurated.

One of the most poignant passages in the whole of the literature of agriculture may be found in a little Latin reading book which was written for English boys of the eleventh century. Each of the boys in the class is made to assume a different character and describe his day's work. This is the ploughman's story :—

> "I work hard: I go out at daybreak, driving the oxen to the field, and I yoke them to the plough. Be it never so stark winter I dare not linger at home for awe of my lord; but having yoked my oxen, and fastened share and coulter, every day I must plough a full acre or more. I have a boy driving the oxen with a goad iron, who is hoarse with cold and shouting . . . . Mighty hard work it is, for I am not free."*

Long after the eleventh century the typical Englishman was the unfree ploughman wearily ploughing the acre strips in the open field. Quite humane and enlightened people could contemplate with equanimity a state of society in which "the poor bondman's son is disposed by his birth to be a bondman all his life, as his fathers have been before him a hundred years."† As Wyclif said: "rulers think it as just and as natural for the whole class of bondmen to serve them and their class in worldly affairs, as it is natural for wood to burn."‡

It is not an accident that improvements in agriculture during the Middle Ages were so slow as hardly to be perceived, and that the recognition of serfdom as a disgraceful anachronism and its consequent disappearance§ should have been followed by that burst of agricultural invention and teaching which marks the seventeenth century.‖ The gradual relaxation of the bonds which had enslaved the unfree labourer not only freed his spirit but it brought about a gradual and subtle change in the attitude of

* Aelfric's Colloquies in *Analecta Anglo-Saxonica*, pp. 19–20; York Powell's translation.

† *Dives and Pauper* (early fifteenth century): Berthelet's edition (1536) p. 33b.

‡ *De Civili Dominio*, i, 247.

§ Cunningham, *Growth of English Industry*, 533–4.

‖ Lord Ernle, *English Farming*, Ch. V:
McDonald, *Agricultural Writers*, p. 67.

the landowners and those who served them. No one who has read Mr. Hammond's recent article in this *Journal**—no one who has an acquaintance with the novels of Fielding, to mention no other writers—will be under any illusion as to the amount of freedom which the farm labourer enjoyed in the eighteenth century; no one who has read the *Husbandry* of Walter of Henley† will be under any illusion as to the attitude of the mediæval labourer to his task. Imperfect as the eighteenth century may have been it held out an immeasurably greater promise than the thirteenth; the teaching of the seventeenth century, which at the time must have seemed often ineffective and futile, was not lost.

In the eighteenth century the passion for agricultural improvement grew and spread until nearly every landowner and many farmers at least affected to be imbued with it. The progress of inclosure at once stimulated and was stimulated by the movement. To an increasing extent men set themselves to devise new and improved implements. So far as the plough was concerned many of the modifications had long been anticipated, for already at the beginning of the sixteenth century, and probably centuries before, there had been great diversity of types to meet the different conditions of different districts.‡ Lord John Somerville, writing in the early years of the nineteenth century, stated on the evidence of drawings published in the middle of the seventeenth century by Walter Blith,§ that little originality of invention or improvement had been manifested in the greater part of the swing and wheel ploughs constructed since that date. He will only admit that two or three improvements "have really borne the test of practice with credit and success."‖ However this may be, there was a great interchange of ideas and conscious effort towards improvement: doubtless there were "numberless fancied improvements," but it cannot be doubted that the general level of plough design was greatly improved. The Rotherham plough, which was highly esteemed in the latter part of the eighteenth century, was itself of Dutch origin: but there were abundance of types in England itself which might

* Oct., 1921, p. 586.

† *Ed.* Lamond and Cunningham, esp. pp. 10, 11.

‡ See the commencement of Fitzherbert's *Book of Husbandry*; the relevant passages may be found in McDonald's *Agricultural Writers*, p. 14.

§ Reproduced by McDonald, *op. cit.* p. 102.

‖ *Facts and Observations on Sheep, Wool, Ploughs, and Oxen*, pp. 129, 130.

suggest improvements to visitors from a distance.* In 1767, the Society of Arts, which had been founded thirteen years previously, distributed three premiums of £50 for plough inventions,† including the skim-coulter plough of Mr. Duckett of Esher, which earned the approbation of Lord John Somerville himself.

The object of improvement was quite clearly recognised to be better cultivation and reduced expense, and the means to these ends were seen to be better implements and greater skill in using them. The problem could not be better stated than by Arthur Young, in 1797; his immediate subject is a ploughing match at Petworth, but his statement of the case was intended to have general application and is as true to-day as one-and-a-quarter centuries ago‡ :—

"There are four distinct species of merit which demand to be appreciated:—

1. The skill of the ploughman.
2. The goodness of the plough.
3. The furrow ploughed.
4. The power of the team.

"The first of these objects is seen in the knowledge with which the ploughman adapts the work to the crop in question, to lay the furrows in such a manner as shall encourage all grass and weeds to vegetate, if (as in fallowing) that is requisite; or, on the contrary, to exclude them from the air as much as possible, as in turning a clover ley for wheat; as well as to vary his depth and breadth of furrow to the object of the farmer. His skill is also seen in the straightness and evenness of his work; in setting his plough to the nature of the soil, and even to the season, whether moist or dry. All these, and several other points, give an opportunity to a ploughman to shew his skill even with a bad plough; and with the best, a bad ploughman will contrive to make wretched work. . . .

"The goodness of the plough is a most essential point; for there are such as no ploughman can make good work with; and some so heavy . . . . . that there must be four horses to draw it . . . . The Kentish turnwrest will . . . . lay the furrows well; but having a chisel point, of only two, three, or four inches wide, and a heel nine or ten, must in various operations drive over roots and weeds without cutting them. The little Suffolk swing plough is a handy tool for three or four inches of depth, but very deficient for a right

* cf. Arthur Young's statement of his own method of proceeding: *Annals of Agriculture*, Vol. I, p. 118, "Mr. Arbuthnot's plough was, beyond all doubt, the best that was tried and plainly owed its superiority to the share rising as an inclined plane and melting gradually into the admirable sweep of its long mould-board. I was present the whole day, and was so convinced of this, that I determined to apply those parts of it to the others of Mr. Brand's construction. I executed the idea in Hertfordshire, without all the success I expected, but I have since brought it to bear, and formed from both, a plough nearer to perfection than any I have yet seen . . . ."

† Dossie, *Memoirs of Agriculture*, 1, 12.

‡ *Annals of Agriculture*, XXIX, p. 514.

staple depth . . . . Instances might be multiplied; but the fact is obvious, that furrows may be well turned to the eye, but yet bad work made.

"Another circumstance of equal importance . . . . is, to consider how well the construction of a plough is adapted to the peculiar soil or crop, which is the object of the experiment . . . . By consequence . . . . the merits of a plough will not be appreciated, if such variations be not in contemplation; and that plough considered as the best which is adapted to the most uses . . . .

"The team does not seem to carry much difficulty in the way of a fair decision; the expense of keeping horses and oxen, or asses. or mules, should be carefully calculated, the interest of their first cost estimated, their duration and liability to disease included, and the expense thus deduced of performing a given portion of work, as merit here is all included in cheapness. But in ascertaining what this portion really is in any trial; that is, the quantum of power exerted; there are great difficulties, if the furrow turned by every plough be not very nearly of the same dimensions: a circumstance that clearly appeared in the trials of ploughs by the Society of Arts, in which the draught was ascertained by means of a coiled spring, with an index of the hundred weights applied in drawing. Probably this difficulty will render it advisable, in such trials, that the furrow to be opened be previously specified; allowing a breadth sufficiently proportioned to the depth required."

A full account of the trials carried out by the Society of Arts had appeared in the first volume of the *Annals of Agriculture*,* under the title, "Experiments to ascertain the force necessary to draw various ploughs." The instrument used was a spring dynamometer such as is still employed for measurements of no great refinement. It was invented by Mr. Samuel More, the Secretary to the Society, with a view to determining the merits of an iron plough which had been submitted by Mr. John Brand for a bounty. Six ploughs in all were tried:—the Rotherham plough; two ploughs of Mr. Arbuthnot's, described merely as "red" and "blue"; Mr. Ducket's trenching plough; the common Surrey plough; and the new iron plough. Twenty tests were carried out, with furrows of different depths, and with weights added to certain of the ploughs to bring them up to the weight of others; the draught was registered in fractions of cwt. Mr. Brand was given a bounty, but Mr. Arbuthnot's plough was "beyond all doubt the best."

The conclusions drawn by the Committee, as Arthur Young said, "deserve no slight attention":—

"It appears that the weight of the plough is of little consequence, very contrary to common ideas; that heaviness is even an advantage oftener than the contrary; and that in some instances to a surprising degree. The weight of the plough is the least part of the horses' labour: the great object is the resistance met with in the cohesion of the earth; lightness does nothing to

* p. 113.

overcome this; it is effected by just proportions only. If a plough is not made on true principles, the lightness is prejudicial by adding to the unsteadiness of all ill-made ploughs.

"It also appears very decidedly, that the share should be nearly, if not quite as broad in the fin, as the plough is wide in the heel, in order that all the furrow may be cut, and not torn up by force."

Ploughing matches appear to have sprung up at about the same date that the dynamometer was invented. The present writers have found no certain reference to ploughing matches earlier than 1784, when the Odiham Agricultural Society held a competition on the Tuesday of Whitsun week, and a prize of three guineas was awarded to the "ploughman that ploughed the best within a given time to be determined by the stewards." Other prizes were given to the boy driving the horses and to the two next best ploughmen and to the boys employed with them.* Similar matches then became not infrequent, but it is clear from Arthur Young's anticipation in 1797 of "the vast effect of such annual meetings, were they to take place in various other districts of the kingdom, as well as Sussex"† that he was then acquainted with but few.

It was not to be expected that all societies would have Arthur Young's wide vision or insist upon the number of factors for which allowance should be made in comparing ploughs and ploughing. Good work, as judged by conventional standards, was a thing easily to be understood, as was also the reduction in the strength of the team (a rough and ready indication of draught) and the possibility of dispensing with the driver. All these points were clearly of importance, while none but powerful and wealthy societies could be expected to concern themselves with scientific refinements.

The evidence of contemporary witnesses is overwhelming that ploughing matches had an immense effect in raising the skill of the ploughmen and reducing the working expenses.

"These ploughing matches," said Francis Erskine, "raise such emulation amongst the youth, that a gentleman has assured me, that, when travelling along the road, he has seen a young lad, (who was ploughing without any person in the field with him), as soon as he came to the end of the furrow, stop, and look back on his work; and on his perceiving part not done to his mind, that he immediately turned, took his plough to the spot, and endeavoured to rectify the error with great earnestness."‡

* *Annals of Agriculture*, III, 50.

† *Annals of Agriculture*, XXIX, 520. Prizes were at this period given on other tests of excellence, as, for example, a prize of "five guineas and a silver cup by the Bath Society in 1784 for ploughing 442 acres of land with a pair of horses without a driver": *ibid.*, III, 50.

‡ *Annals of Agriculture*, XXIX, 332.

"The ploughmen of Clackmannanshire," it was said, "from being notorious for their want of skill in tillage, are now reckoned among the very best in Scotland." This was a direct result of ploughing matches. "The fields of the good farmers, indeed, appear cultivated like gardens." There was, however, a serpent even in this Eden: in some counties the farmers alleged that the matches tended "to make the successful ploughmen saucy and self-conceited, and ready to seek higher wages."* It is hard to accept the workings of the spirit of freedom for good or ill.

In some cases the rules were directed to reducing the number of draught animals and men employed: in the matches instituted by Lord Egremont at Petworth the prizes were awarded for an acre ploughed "in the best manner, with the least assistance, and with the fewest oxen." † Even when the rules were not so definite and the quality of the ploughing merely determined the prizes, the contrast with competing teams could not fail in its effect. At the first match at Alloa, for example:—

"One of the members of the club had a good servant, who was, however, prepossessed in favour of three horses in the plough, with a driver. The master sent him to make the trial, in hopes of convincing him, and his other servants, of their inferiority: and it succeeded: the whole of them being so ashamed of this man's work, as to make them ever since reject and give up asking for a third horse, or a driver."‡

There was, however, a reverse side to the picture. There was a danger lest too wide a generalisation should be based upon the performances under match conditions. Arthur Young suggested to the Bath and West Society that experiments conducted over a period were of more value than competitions in the general use of drills, ploughs or horse hoes,§ while Lord John Somerville stated some years later that he was

"not disposed to draw absolute conclusions from ploughing matches, because much may depend upon accident; besides that exertions might be made for three hours, without much apparent distress, which, nevertheless, could not be maintained for three weeks, and so the public becomes misled."‖

Besides open ploughing matches trials were arranged for the purpose of determining the superiority of particular types or to decide a wager. One of the most interesting of these semi-private trials was that held on the Norfolk Farm in Windsor

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* *Annals of Agriculture*, XIX, 332.
† *Ibid*, p. 511.
‡ *Ibid*, p. 331.
§ *Letters and Communications addressed to the Bath Agricultural Society.* (Ed. 1788.) II. p. 185.
‖ *Facts and Observations on Sheep, Wool, Ploughs and Oxen*, p. 141.

Great Park in 1798 in order to test the qualities of Lord John Somerville's improvement of the West of England double furrow plough against two Norfolk ploughs and one Rotherham plough as ordinarily used on the King's Farm.* The result of this trial was a quite definite indication that the improvements designed by the President of the Board of Agriculture enabled more work to be done under given conditions in a day than could be effected by the use of the single ploughs. About a week later Lord John Somerville's plough was entered in the Petworth ploughing match but did not obtain a prize owing apparently to the fact that it had been damaged during the journey from Windsor.†

Another interesting competition, the basis of which was a wager regarding the relative merits of the single and double furrow ploughs, took place in Essex in June, 1802. The local farmers had been very much opposed to the latter type of plough, but its backer won the wager and the farmers were converted.‡

Scientific or quasi-scientific tests tended to be overshadowed by contests which matched man against man and team against team. The inquiring spirit, the infinite patience that will make the infinite number of measurements which is science: these were not long prominent and emerged only at long intervals. About the year 1800 the names of many more societies engaged in promoting ploughing matches appear in the periodicals,§ but records of careful tests and trials are infrequent.‖ In 1842, however, the Royal Agricultural Society of England allotted 300 guineas to be awarded as prizes for implements exhibited at their annual show, and in the following year "a great number of ploughs were put to work on Mr. White's farm at Rough Heanor and inspected by the judges."¶ It became the practice of the Society to reserve the right to try in the field any implement exhibited,** and the Bath and West of England Society later adopted a rule which permitted exhibitors to show their implements actually at work.†† There

* *Annals of Agriculture*, XXXII, 154. *Journal R.A.S.E 3rd Series* VIII, p. 9.

† *Annals of Agriculture*, XXXII., 154.

‡ *Facts and Observations on Sheep, Wool, Ploughs and Oxen*, p. 143.

§ For an account of measurements of draught with a dynamometer in 1839, see *Jour. R.A.S.E.* I, 140, 219.

‖ E.g. Cardigan: *Annals of Agriculture*, XXIX, 278: Sussex, *ibid.*, p. 587, Manchester, XXXIII, 635; Lancaster, *ibid*, 629.

¶ *R.A.S.E Journal*, IV. 467.

** *Ibid.*, 453.

†† *Journal of Bath and West of England Soc.* (1871) III. p. 197.

appears, however, to have been no sustained attempt to follow on the experimental work inaugurated by the Society of Arts in 1784. Doubtless various forms of tests were carried out by manufacturers as they adopted new designs, but public trials became practically limited to ploughing matches. Of the number held at different times or at any one time in the nineteenth century no estimate appears to have been made or to have survived. Doubtless much might be elicited, if it were worth while, by local inquiry: but we may accept the received opinion that there has been a marked decline within the recollection of the older generation. Recently inquiry was made by the Ministry of Agriculture of County Organisers and others, and from the replies which have been received it would appear that some 250 annual competitions are still maintained in England and Wales. In a few instances tractors are now included, but in the great majority of the matches horse-ploughs alone are entered. In some counties no matches appear to be held even where there is a great deal of arable farming: but it is likely that complete information has not in all cases been in the possession of the Ministry's correspondents.

In England, the county with the greatest number of matches is Yorkshire, where 29 are reported to be held annually: curiously enough no matches are reported from the East Riding. The other counties for which figures are given are as follows:—

21	Suffolk.	4	Berkshire, Buckingham, Hampshire, Surrey.
15	Kent.	3	Worcester.
13	Durham, Essex.	2	Northampton.
10	Lancashire.	1	Cambridge, Cheshire, Cornwall, Gloucester, Hertford, Middlesex, Northumberland, Rutland, Shropshire, Westmorland, Wiltshire.
9	Hereford, Nottingham.		
8	Oxford.		
7	Somerset.		
5	Devon, Lincoln, Sussex.		

In Wales and Monmouth the number of matches appears to be large as contrasted with England. In Pembroke there are 33, in Brecon and Radnor together 24, in Cardigan 20, in Montgomery there are 7, 3 each in Flint and Monmouth, and 1 each in Carmarthen and Glamorgan.

To some extent the national and local tractor trials have taken the place of ploughing matches: and many farmers appraise the work done very much as they would the work at a ploughing match. This is not wholly to the bad, for careful work is as important with a tractor as with a team of horses, provided the standard has a real meaning, a point upon which,

as we have seen, Arthur Young thought it wise to insist many years ago. Whereas, however, most farmers are, or believe themselves to be, good judges of horses, they are rarely good judges of tractors: and the points of a tractor cannot be summed up in the same way. If the tractor is to be the power-unit of the future it will be necessary to take a leaf from the book of the users of commercial motor vehicles, and award prizes for well-kept engines as well as good ploughing. Such competitions, provided the drivers are contented and take a pride in their work (which will only be the case if they are contented), may work a charm not very different from that which the early ploughing matches are reported to have done in improving the work of ploughmen; for the bane of the tractor is the repair bill, and the way of escape is a fuller understanding of the machine, a higher craftsmanship. As for judging between tractor and tractor, that is a matter for prolonged test and scientific study, and if the farmer is to form an independent opinion he must be guided largely by independent reports.

DISEASES OF THE SWEDE CROP IN CUMBERLAND AND WESTMORLAND IN 1921.

R. B. STRANG, N.D.A.

Ministry of Agriculture.

Powdery-Mildew of Swedes.—One of the most prevalent diseases of swedes throughout the country last year was powdery-mildew* and in the northern counties the attack was unusually severe. In the early part of the summer, 1921, the swede crop in practically all parts of Cumberland and Westmorland looked exceptionally healthy and vigorous, and promised, in spite of the drought, to be an excellent crop. About the middle of August, however, mildew developed and after that date the disease steadily became worse and the crop received a severe check. Not only were the older leaves affected, but the young leaves became mildewed before they attained any great size. Rain fell copiously in August, so that the damage to the crop may be regarded as due to mildew and not to drought.

* Another mildew frequently attacks swedes, namely the False Mildew, caused by the fungus *Peronospora parasitica*. This disease is more prevalent in wet seasons and may cause much destruction of the foliage

Swede crops over the whole of the two counties have been examined and the disease found to be equally severe in all parts, practically no difference in intensity being observed with varying elevations, types of soil and aspects.

The disease has undoubtedly caused the farmers considerable financial loss, which may probably be estimated at about £2 per acre. This estimate is calculated as follows:—(*1*) The average yield for the counties is regarded as 20 tons per acre, but the very promising crop has only yielded 18 tons per acre. Valuing the swedes at 10s. per ton, the reduction of 2 tons amounts to a loss of £1 per acre. (*2*) It is the general opinion of farmers that the keeping qualities of swedes attacked by mildew are adversely affected. Maturation is interfered with and owing to the liability of late secondary growths the roots are apt to be soft and unripened. It is possible also that owing to the partial destruction of the foliage by mildew the roots are more liable to crack, and, consequently, an undue proportion would rot in storage. (*3*) It is believed that the nutritive value of swedes attacked by mildew is reduced. If this were so sheep folded on the crop would derive less benefit from the bulbs and the leaves than from a healthy crop. Precise scientific evidence for the headings (*2*) and (*3*) is still scanty, but it is reasonable to assume that at least another £1 per acre may be allowed for the two headings.

With regard to control measures, it is probable that in common with many other mildews the attacks of swede mildew could be reduced by applications of potash fertilisers. At any rate care should be taken that potash is not deficient.

Club Root, or Finger-and-Toe, in Swedes.—This disease, whilst not nearly so severe in Cumberland and Westmorland as it was in 1920 was, nevertheless, generally present. Almost all crops had traces, in some the disease was very noticeable and in a few it was serious. Very few crops (probably not more than half a dozen) have been observed where no disease was found.

Most of the arable land in this district is a light sandy loam, usually deficient in lime, and is therefore highly suitable for the development of finger-and-toe. Swedes, moreover, come round in the rotation usually every fifth or sixth year, and it is well known that five years is not a sufficiently long period to starve out the disease. Taking these two factors into consideration, it is not surprising that finger-and-toe is the cause of huge losses annually in this district.

The swede crop usually follows oats in the rotation, but sometimes potatoes are the preceding crop. It was remarkable last year that where swedes were grown after oats there was more finger-and-toe in the crop than in those crops which followed potatoes. Indeed, the only crops of swedes last year where no finger-and-toe was found, were grown on land which carried potatoes the previous year.

It is also noticeable that there is always more finger-and-toe to be found along the headlands, in the vicinity of gates, and in damp portions of the fields, than in other parts of the field. Portions of diseased roots and contaminated soil are liable to be carried to gates and headlands on boots and wheels, and these would infect the soil very h. avily, but in addition such places are of necessity trampled and puddled, and, consequently, the soil is not so thoroughly aerated as in other parts of the field. It is possible, therefore, that thorough cultivation and aeration of the soil would tend to prevent the disease. Possibly this may account for the fact that swedes following potatoes are freer from finger-and-toe than swedes following oats, since with a crop of potatoes the soil receives more cultivation.

It would seem that early sowing combined with a good seed bed also tends to check the disease. In 1921 most crops in this district were sown early, with the soil in really good condition, and it would appear that the few crops in which the disease was severe were sown late. The most seriously diseased crop observed was sown about the first week in August and 90 per cent. of the plants were affected, the roots being small and stunted. This crop was a complete loss.

Owing to the slightness of the attacks last season the actual money losses sustained by the farmers were almost negligible; this is due probably to the dry summer and early sowing in a good seed-bed. In an average season the losses are much heavier. The damage caused by finger-and-toe in this district in an average season is much greater than the damage caused by wart disease of potatoes. The protective measures for finger-and-toe, and the amount of lime or chalk required, are fully dealt with in Leaflet No. 77.

Dry Rot.—In addition to mildew and finger-and-toe, swedes are sometimes affected by the disease known as dry rot. This disease was first described in 1900 by Professor M. C. Potter.* The disease is caused by a minute fungus, *Phoma napo-brassicae*, which attacks the roots and forms a soft, brown rot, but one

* This *Journal*, Vol. VI, pp. 448–456.

which is dry. It is not very common in England, but occurs in some of the wetter counties and may be locally prevalent in parts of Cumberland and Westmorland and in certain seasons may be responsible for very heavy losses. Dry rot is known to be very much favoured by heavy dressings of nitrogenous manure. Where the disease is prevalent, therefore, farmyard manure should be applied sparingly and care taken that the land is not deficient in lime or potash.

Bacterial Disease.—Another disease with which swedes are affected is wet rot caused by the bacterial parasite *Bacillus carotovorus*. The bacterium gains entrance to the roots by means of minute wounds; high manuring favours the disease and at times a large proportion of the crop may be lost. Last season the rain following the long drought caused extensive cracking of the roots and apparently the wet rot which was found in some fields was due to the parasite gaining entrance to the roots by means of these cracks. Where either wet rot or dry rot is present in the crop special care is necessary as to storage.

CULTIVATION OF THE HOP CROP.

III.—SYSTEMS AND METHODS OF TRAINING.

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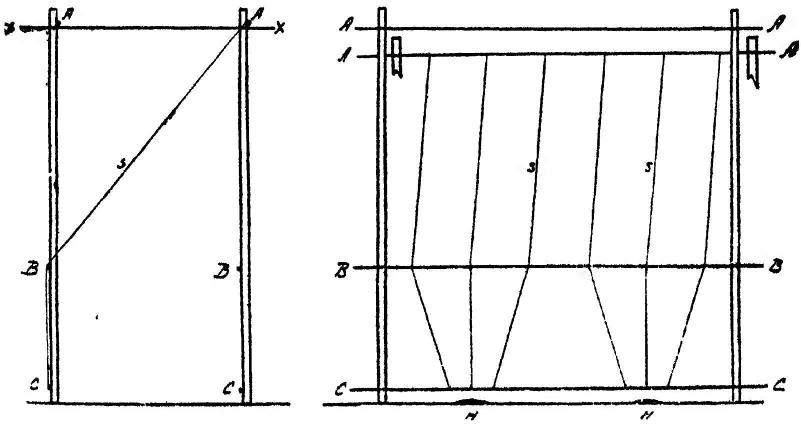
THE hop is a climbing plant. If allowed to grow freely the tip of the stem executes a spiral in a clock-wise sense so that the stem tends to embrace any stick placed in its line of growth and encircles it as it grows. Again, the normal habit of growth is vertical so that a hop stem encircles a vertical support much more readily than one which is sloping. Finally, the hop stems and leaves are thickly covered with reflexed hooks, causing the rough feeling of the hop-bine, so that when once the stem has encircled its support the hooks cling to the support and tend to hold the stem in position upon it. In all systems of hop training advantage is taken of these chracteristics of the growing hop stem for supporting the bines.

Polework.—In earlier times 10 ft. to 16 ft. poles alone were used as a means of support. Three or four of these comparatively thin poles were set in the ground around each "hop-hill" with the tips of the poles slanting outwards, and the hops were tied to the poles by means of rushes or bast—hence the origin of the word "tying." Very few hops are grown on poles alone

at the present time, though a few grounds may be found in which two poles are placed to each " hill " and string led from a height of 8 ft. 6 in. on the poles of one row to the tops of the poles in the next.

Systems of Wire-work.—Generally, at the present time hops are grown upon one of several systems of wire-work. The wire consists of galvanised stranded wire composed of 3 to 5 or 7 strands according to the strain which it will be required to support. The wire framework is carried upon stout poles cut generally from larch, spanish chestnut. ash or occasionally spruce and other woods. Before use, the poles should be roughly shaved of their bark, seasoned and dipped in hot creosote, 2 ft. 6 in. to 3 ft. high, so that the part most likely to decay—just above and below the surface of the ground—may be adequately protected. With the softer woods, such as spruce, the poles should be dipped from end to end or their " life " will be short. The poles are sharpened and set from 18 in. to 2 ft. in the ground, and vary in height from 11 ft. to 16 ft. above ground and in a few cases are even higher.

This wire-work supports the string, upon which the hop-bines climb. In England the string is universally made of coconut fibre, which is rough; in America cotton string is more frequently used because it is cheaper there, but cotton is smoother and the hops do not cling so well in windy weather. The string should have a breaking strain of 50 to 60 lb., and should be uniform and run out at least 100 yards per pound.



Butcher System of Training Hops.

AA, top wires; BB, middle wires; CC, bottom wires; XX, cross strain wires H, hop hills; S. strings.

FIG. 1.—End view. FIG. 2.—Side view.

The Butcher System (Figs. 1 and 2).—This system was introduced by the late Mr. Tom Butcher, of Selling, and was the first system of wire-work to be adopted in England. Originally the system was applied to a hop garden, the hills of which were planted rectangularly 6 ft. 6 in. apart in each direction, making about 1,000 hills per acre. The poles were placed in such a way that 2 hills were situated between them in every row of hops so that 500 poles were required per acre. The poles were 12 ft. out of the ground and three horizontal wires were attached to each row of poles; the bottom wire was 6 in. above the ground; the middle wire was between 3 ft. 6 in. and 4 ft. high, and the top wire was fixed about 6 in. below the top of the poles. The wires in each case should be fixed with staples which should be driven in obliquely to the grain of the pole.

Three strings were tied to each hill in such a way that they spread out like a fan from a point on the bottom wire just above the "hill" to be equally spaced upon the middle wire immediately above, and then sloped parallel and equidistant from each other to the top wire on the next row of poles. Since the slope of each row of strings is in the same direction, the pull on the wire-work, especially when the growth of hops is heavy, is very great and all in the same direction: in order to withstand this, specially stout cross-wires have to be fixed to each row of poles at right angles to the alleys and anchored substantially at the outside of the garden. The slope of the string should preferably be away from the prevailing wind; since this is generally from the south-west the strings should slope towards north-east; with this slope the bines are not so badly blown from the string in windy weather, nor are the hop cones so badly bruised by a wind when reaching maturity.

Butcher's original specifications have naturally been modified in many ways by different growers; thus the hops in the rows are frequently 7 ft. and even 7 ft. 6 in. apart so as to allow a wider space between each string and prevent so much matting together. The alleys also are frequently 7 ft. to 8 ft. wide to allow more room for the passage of horses with tillage implements, hop-washers, etc., but the wider rows mean that the slope of the strings becomes flatter and the hops may fail to encircle the string with each spiral in their growth so that training becomes very expensive; in order to obviate this the height of the poles and the top wire is frequently raised to 14 ft. or even 16 ft.

The advantages of the Butcher system are considerable and it is still largely adopted. In particular the hops are well

exposed to sunlight and air so that they are enabled to develop healthily into fine large hops; the bines are all suspended in one plane and are therefore capable of easy spraying with the hop-washer, except when the bines get round the top of the poles, by which they are protected from the spray; as compared with the old pole system (and this is true of all wire-work systems) the hops can be easily pulled down so that picking is simplified. On the other hand, from the very fact that all the bines are suspended in one plane close together, they tend to become interlocked with each other and this leads to much shattering when they are pulled down for picking. Again, when planted in wide rows, especially if frequent winds blow

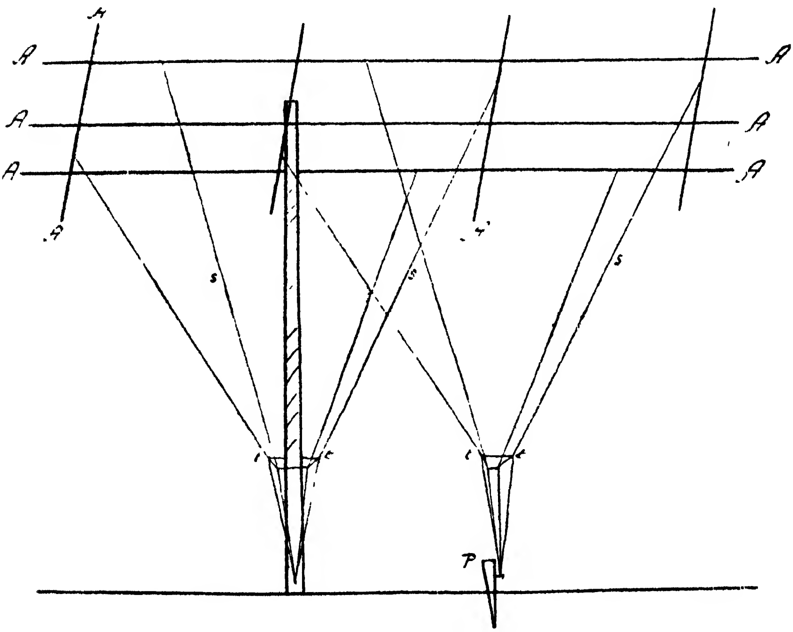


FIG. 3. Umbrella System of Training Hops.
AA, top wires. S, strings; TT, coupling strings. P, stump.

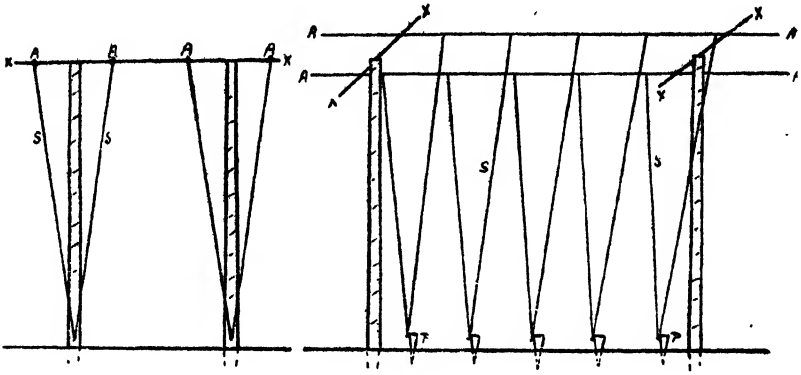
against the slope of the string, the bines fail to encircle the string and much hand training is required to keep the bines growing on the string. Another minor disadvantage is the fact that the bottom and middle wires prevent the passage of horses and implements for cross tillage, but as counterbalancing this is the fact that when a middle wire is present and cross tillage not practised, bines can be led from a strong " hill " to furnish the strings on adjoining weak or dead " hills."

The Umbrella System (Fig. 3), which takes its name from a somewhat fanciful resemblance to the spokes of an umbrella, is commonly used in the Weald and Mid-Kent. The spacing of the hills is similar to that in the Butcher system, but the poles, instead of being situated at intermediate distances between the hills are placed closely in contact with the hills: they are arranged symmetrically and generally 1 pole is provided for every six "hills." No bottom and no middle wires are fixed, but the top wires cross each other above the centre of each hill. Four strings are used for each hill and are attached below to a peg or hook fixed in the ground; the four strings are coupled together at about 3 ft. 6 in. above the ground by a string which is hitched to all of them so that each of the 4 main-strings forms a corner of a 9 in. square. From this point the 4 strings radiate at right angles to each other and are tied to cross-wires which form a square above the hills nearest to the central hill, as shown in the diagram.

The advantages of this system are that four strings are obtained for each hill instead of three, they are exposed to the air more advantageously, and cultivation and washing can be executed in both directions. Moreover, since the pull of one string balances the pull of the string opposite to it, the strain upon the wire-work is more or less balanced and the wear and tear is less; consequently fewer poles are required—generally about 160 good poles per acre. On the other hand, spraying by horse-drawn hop-washers is rendered more difficult by reason of the crossing of the strings so that one bine protects another from the spray, and in districts where aphis is abundant this is a serious drawback; the slope to the strings is considerable and consequently training is increased; lastly exposure to light is not so good as in the Butcher and consequently the bines do not hop down so well—the lower bine carries no hops, and the hops do not grow out quite so well.

The Worcester System (Figs. 4 and 5) was first practised in the hop districts of Worcester and Hereford. In the typical case the "hills" are planted in rows 7 ft. or 8 ft. apart, but the "hills" in the row vary from 3 ft. 3 in. to 3 ft. 6 in. apart only. Poles are placed from 15 ft. to 20 ft. apart in the rows, and the wires which carry the string are not directly attached to the poles, but are carried upon stout cross-wires; two top string wires are suspended upon these cross-wires over each alley, equidistant apart from each other and from similar wires in adjacent alleys. Two strings only are supplied to each hill;

these are fastened to pegs or hooks in the ground, and led in opposite directions to the nearest string wires above, usually without any coupling at breast level. The slope given to the string is much less than either in the Butcher or in the Umbrella, but on the other hand the top wires are generally higher and in some cases even 18 ft. high.



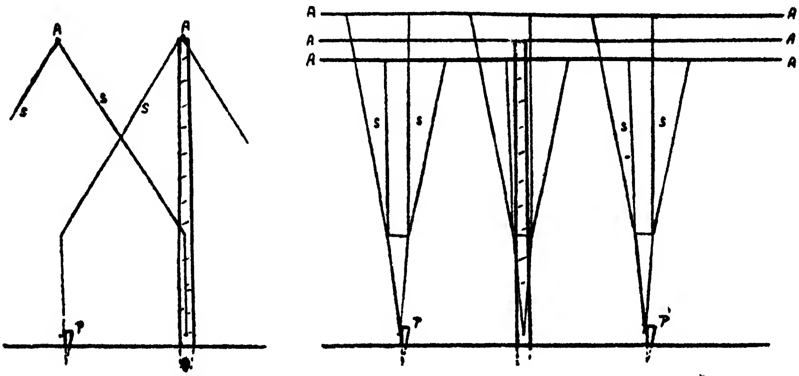
Worcester System of Training Hops.
XX, cross straining wires; AA, string wires: SS, strings: PP, pegs.
FIG. 4.—End view. FIG. 5. Side view.

The advantages of the Worcester System are considerable; the heads are carried over the centre of the alley and are consequently more easily washed than with any other system; the heads are well exposed to light and air, and because the slope is more nearly vertical less training is required. As in the case of the Umbrella System, the pull of each string is counterbalanced so that the strain on the wire-work is not great. The disadvantages are that cross cultivation is impossible and that a greater number of "sets" are required in planting in the typical case, but this cost may be overcome if 4 strings are supplied to each hill and these distributed along a middle wire.

The Cross Butcher System (Figs. 6 and 7) is the most recent development of stringing systems; it is a modification of the Butcher System so as to obtain the advantages of the Umbrella System. The hills are planted as for ordinary Butcher work, but the poles are set like the Umbrella close against the hill. On the other hand the cross-wires are not carried over every hill but over every second hill, and, consequently, the poles are set in rows in two directions as in the Butcher work. No bottom or middle wires are necessary. Four strings are used for each hill; they are tied to pegs below, coupled in pairs at

3 ft. 6 in. high and then two are sloped forwards and two backwards to the string wires along the alleys in front and behind. The advantages and disadvantages of this system are little different from those of the Umbrella System.

Stringing Practice.—As previously stated the type of string used for hops in England is coconut, to which on account of its rough character the hop bines readily cling. The operation of stringing the hops is winter work and is generally carried out after Christmas, and should be completed before other work becomes pressing in spring.



Cross Butcher System of Training Hops.
AA, string wires; SS, strings; PP, pegs.
FIG. 6. -End view. FIG. 7. Side view.

Various methods of attaching the string are practised; most commonly the strings are first cut to the required length, then tied to the top wire by men walking upon stilts and finally tied down to the bottom wire or pegs in the ground. In other cases the "continuous" stringing system is practised. In this a hook is fastened to the wire wherever the string requires to be attached, or in the case of pegs a nail is driven in; the operator is provided with a long rod with an eye-hole at the top, through which the running string passes; with this he hitches the string to each of the points of attachment in turn, without cutting the string. The "continuous" string system is more expeditious, but suffers from several disadvantages—the hooks tend to slip, or if a new plan is desired, are not easily moved, and again if wire-work has to be taken down for re-erection the hooks are inevitably in the wrong place; lastly, if a breakage occurs it usually leads to the falling of two or more strings.

A system of stringing widely adopted on the Pacific Coast of America offers some advantages in the case of Worcester work; in this plan the string wires are attached to the cables at the end and to the cross-wires along the length of the alley by means of hooks, so that they can be let down to the ground for stringing and again for picking. The economy in cost of stringing is not great, but the method would save much shattering of hops during picking. It is worth investigating from the experimental point of view at Wye or Malling.

Management of the Growth of Hop-Bine.—In hop-growing nothing is more important than the attainment of a perfect growth of bine so that each string is adequately furnished and produces its quota of ripe hops. Many factors contribute to this end and the hop grower needs to perfect good plans and see them carried out. Perhaps the first point of importance is the maintenance of strong hills. Sir A. D. Hall showed, when he was Principal of Wye College,* the importance of leaving the stem attached to the root till the foliage had died and the reserve food formed by the leaves after picking had been stored in the root-stock, as compared with the alternative practice of cutting off the stems at or soon after picking.

Whilst it is important to maintain the hop hills in a state of vigorous growth, it is equally important that they be not allowed to become overgrown and straggly; for this reason the hills require to be cut during each winter period as described in the first article of this series.†

Pulling.—Pulling is a practice carried out as a means of equalising and regulating the growth of the hop-bines, so that these may produce fine, short-jointed and yet vigorous growth. In most seasons and especially when cutting has been executed early in the season, the hills shoot irregularly, produce a relatively small number of coarse bines and require to be pulled once or twice and sometimes three times during April and early May before they are put to the string. Pulling is also regulated to the strength and vigour of the garden, young hops requiring little or no pulling, while vigorous hops in their third or fourth season benefit by hard pulling. Other factors requiring consideration when deciding to what extent pulling shall be carried out are the characteristics of the variety, the character and richness of the soil, and the length of run which the bines are required to make in order to furnish the strings. Unfortunately

* A. D. Hall, *Journal of the South Eastern Agricultural College*, 1902.
†This *Journal*, January, 1922, p. 891.

from the nature of the case this method of regulating hop-growth can only be carried out at the beginning of the season and little or no effort seems to have been made to regulate growth at any other season save by the amount of plant food supplied. This is not, however, the only possibility. For instance, it would seem that growth might be easily and perhaps more satisfactorily regulated by checking the bines at or about the level of the middle wire—say, 4 ft. high—by breaking off the heads of the strong shoots only. The weaker stems would then grow normally but the broken stems of the strong shoots would produce two or more fine short-jointed side-shoots which could be used to perfect the furnishing of the strings. By this means growth could be accurately controlled at least a month later in the season. It is not suggested that any grower should adopt this suggestion on a large scale without trial, but it seems to be a fertile line for investigation.

Tying usually commences in the first or second week in May, a start being made with the early varieties. The work is best executed by women, though sometimes a gang of boys may be utilised; in any case, it requires to be very carefully supervised or irreparable damage may result. The operation consists in distributing the bines to the strings provided for each hill so that two or three bines, as desired, may be put to each string. Great care must be taken to see that each string to the hill is equally furnished and tying will have to be repeated several times before all the strings receive their quota of bines. As soon as this is done all surplus shoots are pulled out so that growth may be concentrated in those which have been put to the strings. In cases where a hill has died or is very weak and blank strings would otherwise result, extra bines should be led from neighbouring hills to cover these strings in such systems of wire-work as the Butcher, where middle wires are provided.

By the beginning of June all the strings should be furnished and the hops should have reached the middle wire and be growing vigorously; meantime all surplus shoots as well as any runners should be constantly pulled. By the time the heads are beginning to reach the top wire the lowest leaves on the bines are stripped; this operation is carried out chiefly because the lower leaves are inaccessible to the sprayers and so tend to become breeding-grounds for the hop aphis. Stripping is later continued to the height of the middle wire and sometimes a foot or two beyond, but it should not be forgotten that the

stripping of the leaves weakens the vigour of growth, and, consequently, must not be carried too close to the growing point, especially in the case of weak hills.

Training.—The responsibility of the tyer is generally supposed to have ended by the time the heads of the bines have been placed upon the sloping strings, but this does not complete the training; for if the strings have a considerable slope or if windy weather prevails some of the bines are blown away from the strings and require to be replaced. This necessitates frequent trainings at first from the ground or with short steps, and later on by men on stilts or with ladders until the bines have grown over the top wire. This stage with most varieties should be attained by the end of July, at which time training may be said to be complete.

GLOUCESTERSHIRE OLD SPOTS PIGS.

SANDERS SPENCER.

UNTIL recent years it was not generally recognised that in these islands we had several quite distinct types of pigs which, notwithstanding the fact that no particular and continued attempts have been made to preserve their special characteristics, still retained their peculiar points, which were transmitted generation after generation to their progeny.

One of these, which might probably be termed original types of pigs, was of a black and white or, as it appears to be becoming more every year, a white and black spotted colour, has been found for many years in the County of Gloucester and the adjoining districts. The persistency with which boars of the Gloucestershire Old Spots breed impress their peculiar colour on their progeny, even from sows of other breeds and colour, appears to prove that the breed is actually an original one and not the result of chance or of crossing two or more breeds within recent times. In the first volume of the herd book of the Gloucestershire Old Spots Society it is claimed that if a Gloucestershire Old Spots boar be mated with a sow of any other pure or cross-breed the resultant produce will almost certainly be a litter of pigs of a spotted colour and with the well-known type of ear of the sire. No record is given of the extent to which experiment on this point has been carried, nor whether the crossing of a Gloucestershire Old Spots sow

with a boar of the Large or Middle White breeds would give similar results as to colour, form and hang of ear. This last point is mentioned because it is claimed by breeders of Large White and Middle White pigs that if a boar of either of these breeds be mated with a coloured sow of any other breed, the large majority, if not the whole, of the pigs of the resultant litter will be of the colour of the sire. The two claims might give rise to a discussion on the comparative powers of the respective sires to influence the colour of the offspring. If it be admitted that the boars of the Large White, Middle White, and Gloucestershire Old Spots boars do impress their particular colour or markings on their produce from sows of any other breed or cross, then the claim that a spotted pig is of equally pure a breed as the white pigs must be conceded, just as it is generally admitted that the white pigs named are a distinct breed.

The question as to the original cause or causes of pigs of differing colours being more or less confined in olden times to varying districts has been a subject of keen discussion for many years without any decisive results. The difficulty of discovering a solution to the question has not been so great with regard to pigs of whole or distinct colours, as in these cases the variations may have been due to the differences in the colour of the soil, the herbage, and woods and forests in the different districts in which, in olden times, the pigs roamed in a more or less wild state. The real difficulty arose when an attempt was made to discover the cause of the peculiar markings which appear to be natural to pigs of the Gloucestershire Old Spots, the Sheeted or Saddleback, etc., breeds. To what we can attribute the spotted appearance of the first named and the white mark over the shoulders and down the fore-leg of the latter breed is not clear. Yet the peculiar markings are persistent, so that it would appear that some good and sufficient cause existed in the past for these markings of some breeds of pigs and the whole colour of others.

The causes of the present form, size and quality of the Gloucestershire Old Spots pig appear to be much more readily discovered. As in other districts, the causes have been the requirements of the pig-breeders and of consumers. In some portions of the County of Gloucester the elevation of the farms is high, and consequently a pig of a robust nature was needed. In other portions, especially in the vales, milk production is largely carried on, and within comparatively recent years butter-

Fig. 1. Young Gloucestershire Old Spots Boar.

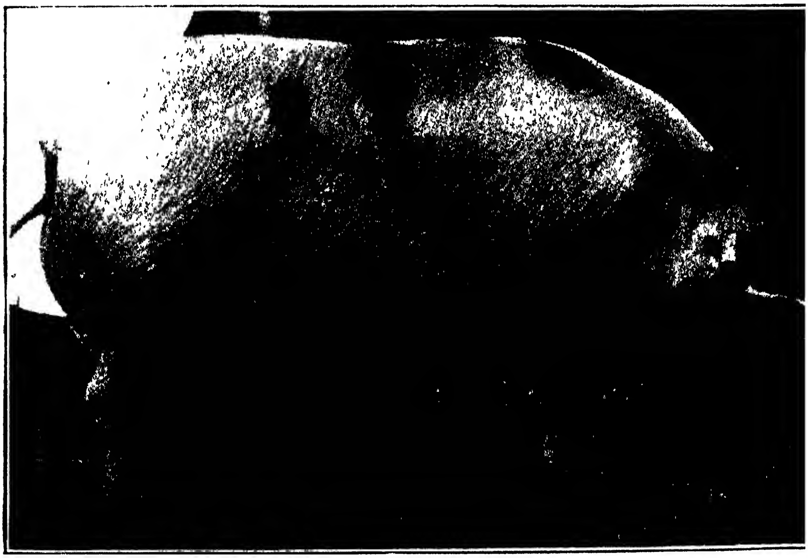


Fig. 2.—Gloucestershire Old Spots Sow.

making and cheese-making were commonly followed, so that a considerable number of strong and healthy pigs were required for the consumption of the skim milk and butter milk and the whey. Further, because a very large number of small holdings were in the occupation of a thrifty and hard-working race of farmers, pigs which could be converted into bacon for the summer supply of animal food for the farmers and their large families were equally necessary. Probably it was owing to these, rather than to any other causes that the evolution of the hardy, prolific and quick-growing pig, most suitable for the manufacture of large, thick and heavy sides of bacon, and now termed the Gloucestershire Old Spots pig, was brought about. It may be asked why these qualities should be less persistent now that the conditions have changed, whilst there exists so great a difficulty in retaining points which at the present time are deemed to be necessary, in the pigs of other breeds, in order to command success in the various showyards? One answer which might be given is that these particular characteristics, referred to as being common in the Gloucestershire Old Spots pigs, are more or less inherent and natural to the breed, whereas the peculiar points referred to as necessary for the successful exhibition of pigs of most breeds are mere fancy points, more or less the result of chance, and therefore not natural to the animal and of little or no practical value.

If further evidence of the many good qualities of the Gloucestershire Old Spots pig was required, proof would be furnished by the phenomenal success of the Society established only some 8 or 9 years since. No other pig society has such a record. This wonderful success must have been due to a large extent to the inherent good qualities of the spotted pig, but it could not have been achieved had it not been for the vast amount of successful effort bestowed on the Society by the original Council and the Honorary Secretary of the Society.

The Gloucestershire Old Spots pig has found new homes in most parts of the country, where it has become noted for its hardiness, its quick growth, and its ability to grow into a large fat pig comparatively early in life. These were the qualities amongst others that made it so great a favourite in the county of its origin, and they are still thoroughly appreciated in other districts. Now that the numbers of the particular breed have so enormously increased, however, the pork trade alone will not be able to absorb all the fat pigs produced. In order to give some idea of the great extension of these spotted pigs, it

may be pointed out that the first volume of the herd book, published in 1915, contained the pedigrees of 39 boars and 247 sows, or a total of 286, whereas the seventh volume, published last year, contained the entries of 1,407 boars and 5,382 sows, or a total of 6,789 entries.

So enormous an addition in so short a period to the number of breeding pigs of this particular breed must necessitate the seeking of some outlet for its fat pigs other than the fresh pork trade. The requirements of the bacon curer must be studied so that the surplus fat pigs can find a good market. It is quite possible that the Gloucestershire Old Spots pig, having been bred for so many years with a view to the supplying of the fresh pork markets and the old style of bacon manufacturers, may be in need of some slight alteration in its general character, as the form and degree of fatness of a side of bacon of the present day varies very considerably from one of, say, forty years ago. Length of side of the pig is now most important, and squareness of hindquarters is an indication of a fashionably shaped ham—for, strange as it may seem, there is such a thing as fashion in hams, or a compliance with the needs or fancies of purchasers, irrespective of some increase in the cost. Another point which producers of bacon curers' pigs should study is the fineness of bone, or perhaps it could be more clearly described as lightness of offal. This reduction in the weight of the head, the legs, the tail, etc., affects the pork purveyor and the bacon curer far more than the butcher is affected by the weight of the offals of cattle, sheep, and calves, since in the latter case the offals are given in with the fat animal, whereas in the former instance the offals are purchased at the same price as the body of pork. Reduction in the weight of the bone in the carcass of the pig, therefore, may at first sight appear to affect only the consumer, but its effects are greater, as a manufacturer gains or loses credit by his success or failure to satisfy his customers by furnishing to them an article which best answers their purpose. The object in calling attention to various points in these articles is not for the purpose of criticism, but to offer suggestions which in the writer's opinion might, if adopted, prove of benefit to the admirers of the different breeds of pigs. What is termed by the Gloucestershire Old Spots Society as " a standard for a typical G. O. S. Pig " is as follows:—

Head—**Medium length and wide between the ears, nose wide and medium length, slightly dished.**

Ears—**Rather long and drooping.**

Jowl—Medium size.
Chest—Wide and deep.
Shoulders—Well developed, but not projecting, and in line with ribs must not show any coarseness.
Back—Long and level.
Loin—Very broad.
Sides—Very deep and presenting straight bottom line.
Belly and Flank—Full and thick.
Quarters—Long, wide and not drooping.
Tail—Set high, of moderate size, yet fairly strong and long carrying brush.
Hams—Large and not flat and well filled to the hocks.
Legs—Short, straight and strong.
Skin and Coat—Skin light or dark, must not show coloured splotches otherwise than beneath the spots of the coat, the latter should be fully and fairly thick, hair long and silky but not curly, with an absence of mane bristles. Colour: white spots on black ground or black spots on white ground. Such spots to be of medium size.

Objections—Head narrow, face and nose dished.
Ears—Thick, coarse or elevated.
Coat—Coarse or curly with rose; bristly mane or decidedly slate or sandy colour; skewbald or saddleback markings.
Wrinkles—Highly objectionable, almost to disqualification.

Quality to be especially considered by judges.

THE SPRAYING OF CORNFIELD WEEDS WITH SULPHATE OF AMMONIA.

JOHN PORTER, B.Sc., N.D.A., N.D.D.,

County Agricultural Organiser for Buckinghamshire.

THE object of the trials described below was to discover an alternative to copper sulphate solution as a spray for destroying charlock and other weeds in corn fields.* For several years past a 3 per cent. solution of copper sulphate (30 lb. copper sulphate to 100 gal. of water) has generally proved effective for this purpose,[1] and from the point of view of killing charlock it is

* Reports on the spraying of charlock and other weeds have recently been received by the Ministry from a number of centres. They include accounts of trials with sulphate of ammonia furnished by Mr. R. C. Gaut (Agricultural Organiser for Worcestershire) and Professor R. G. White (University College of North Wales, Bangor.) The numeral references indicate notes at the end of this article which have been prepared from these two reports by officers of the Ministry.

very satisfactory. It has, however, two drawbacks, viz :—(*a*) copper sulphate is poisonous and on this account requires to be used with care, and (*b*) although it does not kill the cereal crop, it checks it, as a rule, with the result that the crop may require stimulating subsequently with a suitable nitrogenous manure.

It would, however, be a great step forward if some material could be found which would have the dual effect of killing the charlock, etc., and at the same time stimulating the cereal crop. Fortunately, there is reason to believe that a solution of sulphate of ammonia possesses this dual effect, as will be gathered from the experiments referred to below.

Herefordshire Experiments.—When the writer was Agricultural Organiser for Herefordshire, one of his Committee had a crop of winter wheat which was being over-run with the Corn Buttercup (*Ranunculus arvensis*), and he was particularly anxious that some means of dealing with it effectively should be discovered. Some French experiments showed that a solution of sulphate of iron was slightly more effective than a solution of copper sulphate.

Sulphate of iron, however, was difficult to get at that time (1920), and as a strong solution had been used (about 15 per cent.) the cost would have been prohibitive. Bluestone (copper sulphate) was therefore used. At the same time, seeing that some of the highly soluble nitrogenous manures burn the leaves of crops under certain conditions, it was decided to test the effect of solutions of nitrate of soda and sulphate of ammonia. The strengths of solutions used were as follows :—

(*a*) Copper Sulphate 3 per cent. solution.

(*b*) Nitrate of Soda—1 cwt. dissolved in water and made up to 60 gal.

(*c*) Sulphate of Ammonia—1 cwt. dissolved in water and made up to 60 gall.

(*d*) Sulphate of Ammonia—2 cwt. dissolved in water and made up to 60 gall.

Nitrate of soda was not easy to dissolve completely in water owing to the large size of its crystals. It was, therefore, a little troublesome in blocking up the spray nozzles, and further the solution acted on the rubber tubing, causing it to collapse. Sulphate of ammonia, on the other hand, dissolved rapidly in water and did not tend to block up the spray nozzles when previously strained through an ordinary bag.

The results of these trials were that the *copper sulphate spray* had the usual burning effect on the Corn Buttercup[2] with a slight burning effect on the leaves or " flag " of the wheat. *Nitrate of*

soda had very little burning effect on the Corn Buttercup leaves and in a few days was pushing on both the Buttercups and the cereal crop. The stronger solution of sulphate of ammonia was much more effective than the weaker spray in checking the Buttercup, and within a week its stimulating effect on the wheat crop was quite obvious. The yellowish colour and stunted appearance of the wheat on the plot sprayed with copper sulphate solution was very pronounced as compared with the much greener and taller plant on the sulphate of ammonia and nitrate of soda plots.

Experiments with Sulphate of Ammonia in Bucks.—During 1921, in connection with the Bucks Agricultural Instruction Sub-Committee, the writer had further opportunity of testing the effect of sulphate of ammonia solutions. Centres were selected for this purpose in different parts of the county, each plot being about 1 acre in extent.

An ordinary "Strawson" charlock sprayer was used, and conveyed from centre to centre in a Ford van. The pump, spray barrel and spray bar were fitted into a farmer's cart. The spray fluid was made as follows[3]:—Approximately 40 gal. of water was poured into a wooden tub of about 60 gal. capacity, then a 2 cwt. bag of sulphate of ammonia was shovelled in with a spade, each spadeful being given a shake so as to distribute it in the water. At the same time another man kept stirring the solution with a stout pole. With sulphate of ammonia in good condition, it was practically all dissolved by the time the bag was emptied. The sulphate of ammonia appreciably increased the volume of the solution, so that much less than 20 gal. of water had to be added to bring the volume up to 60 gal. This needs to be borne in mind, as one would obtain a weaker and less effective spray fluid, by adding 2 cwt. of sulphate of ammonia to 60 gal. of water.

Careful notes were made of the effect of the sulphate of ammonia spray on all the weeds which happened to be present in the cereal crops, and a good deal of information has been gathered in this way.

It should be remembered that last year was abnormally dry, very little rain falling in Bucks from the beginning of the year till harvest time. Hence the weeds were tougher and more difficult to kill than usual, while the stimulating effect of the spray on the cereal crop was not nearly so marked as was the case in 1920, largely because there was practically no reserve of soil moisture to keep the cereal crop going. The usual

smothering effect of the cereal crop therefore was not so apparent and this gave the weeds a unique opportunity of reviving, where they were not absolutely killed out.

Effect of Sulphate of Ammonia Spray on Various Weeds in Bucks.—The spray fluid was 2 cwt. of sulphate of ammonia dissolved in water and made up to 60 gal.[4]

GROUP I.—SPRAY EFFECTIVE IN 1921.

Charlock (*Sinapis arvensis*, Linn.).—This particular weed was not very common in spring-sown cereals during the past season in Bucks, although one very like it in many respects was abundant, as is explained below. However, at those centres where it was present, the spray destroyed the charlock satisfactorily.[5]

Wild White Mustard (*Sinapis alba*, Linn.).—This plant is easily confused with ordinary charlock in its earlier stages of growth; but the pod is very distinctive. The beak of the pod is longer and broader than the rest, whereas in charlock the beak is shorter than the rest of the pod This was the prevailing cornfield weed in the Chiltern Hill district. It was sprayed at some centres immediately it came into rough leaf. whereas in others it had got into full. flower. However, the leaves were badly burnt, the flowers destroyed and seeding very largely prevented. At both stages the spray was most effective.

Ivy Leaved Speedwell (*Veronica hederæfolia*, Linn.).—This weed was common in some of the cornfields in the Vale of Aylesbury. On account of its spreading habit it tends to smother the young cereal plants. The spray appeared to destroy this weed completely.

Sheep's Sorrel (*Rumex Acetosella*, Linn.) was only common in one or two centres. The spray fluid appeared to be quite effective in destroying it.

GROUP II.—PARTIALLY EFFECTIVE IN 1921.

Corn Buttercup or *Starveacre* (*Ranunculus arvensis*, Linn.).—This weed was fairly common among winter wheat on the stretch of land extending from Stony Stratford to Chaddington. It grows up to 18 in. high. has a smallish yellow flower and black spinous fruits. In Herefordshire these black fruits are called "harvest lice," and the spines do undoubtedly suggest legs.

When these plants were sprayed during the earlier stages of growth,[6] the leaves were withered up and it appeared for two or three weeks that the plants were quite destroyed, but after this time a proportion of the weeds recovered, and ultimately produced seeds. The spray, therefore, was not quite so effective under

the abnormally dry conditions of 1921, and further trials are necessary to see if the spray is more effective in a normal season, as was the case in Herefordshire in 1920.

Other Buttercups, named "Crazies" locally, included the Creeping Buttercup (*Ranunculus repens*), the Upright or ordinary Field Buttercup (*R. acris*), etc. In these cases all leaves which the spray hit were badly scorched, but after about three weeks a good proportion showed signs of recovery.

Dandelion (*Taraxacum Dens-leonis*, Desf.).—All leaves hit with the spray were badly burnt, but, like buttercups, many recovered after about three weeks.

Broad Dock (*Rumex obtusifolius*, Linn.).—In some of the cornfields selected for spraying, docks were fairly common. The spray was very severe on the leaves, and growth was temporarily checked; but after a few weeks the docks began to produce new growth.

Common Field Thistle (*Carduus arvensis*, Curt.).—In this case, wherever the "spray" hit the leaves they were badly scorched, and where thistles had been damaged previously either by the horses' feet, or the cart wheels, they appear to have been killed outright, but the others recovered after two or three weeks.

GROUP III.—ALMOST INEFFECTIVE IN 1921.

Black Mustard (*Sinapis nigra*, Linn.).—This weed appeared to be confined to the cornfields in one parish near Aylesbury. Only one field containing it was sprayed and that after the plants had come into flower. At this stage the plant was tall and possessed long tough stems bearing few leaves. The flowers are small and yellow. The spray fluid burnt the leaves somewhat, but did not destroy the flowers or prevent seeding. Further trials are required to see if the spray will destroy this plant in its early stages of growth.

Black Bindweed (*Polygonum Convolvulus*, Linn.) and *Milk or Sow Thistle* (*Sonchus arvensis*, Linn.).—The spray does not appear to injure these plants.

Stimulating Effect of the Spray on the Cereal Crop.—At one centre, viz., Saunderton, Nr. Princes Risborough, a patch of spring oats, containing Wild White Mustard, was sprayed as follows:—*Plot 1*. No spray. *Plot 2*. 1 cwt. sulphate of ammonia dissolved in water and made up to 60 gal. *Plot 3*. 2 cwt. sulphate of ammonia made up to 60 gal.

The stronger solution (Plot 3) was much more effective in destroying the mustard than the weaker solution on Plot 2, and this in turn compared very favourably with Plot 1.

At harvest time the three plots were kept separate to see whether there was any improvement in the cereal crop owing to the spray. The following are the results:—*Plot 1.* 32 bus. per acre; *Plot 2.* 36 bus. per acre; *Plot 3.* 44 bus. per acre.

Important Practical Points in Spraying.[7]—1. One should insist on having sulphate of ammonia in dry condition for this purpose, as the damp, lumpy grades take much longer to dissolve, and the lumps need to be broken down from time to time during stirring.

2. Always strain the solution into the spray barrel. For this purpose copper gauze is useless, as the spray fluid corrodes it. The best way is to cut open a basic slag bag and strain through one thickness only. The single thickness is very effective in removing any foreign matter from the liquid and in preventing blocking up of the nozzles.

3. Select a dry day for spraying. If the leaves are not dry, the solution is diluted and consequently less effective. Further, the sulphate of ammonia solution dries rapidly on a fine, sunny day. It is this "dry" sulphate of ammonia distributed uniformly over the whole plant, which draws the moisture out of the protoplasm of the cells and, as a result, kills the plant by what is technically called "Plasmolysis." A dry day, therefore, increases the "killing power" of the spray.

4. A calm day is equally important, as it is impossible to cover the leaves of weeds completely in a wind, and the fine misty spray is largely wasted. It also takes considerably more spray fluid to cover an acre, whereas on a calm day 60 gallons should spray about 1¼ acres provided one has a good man driving the horse.

5. Although Charlock can be killed after it comes into flower it is much better to spray it as soon as possible after it comes into rough leaf. The cereal crop then gets the benefit of the manurial constituents of the soil which otherwise would have been taken up by the charlock.

6. Sulphate of ammonia spray fluid has a very corroding effect on the usual charlock spraying machines, which are made of copper or alloys of copper. Chemical action takes place between the copper and the sulphate of ammonia, forming sulphate of copper, and, if the sprayer were not washed out immediately with clear water, the nozzles and pump would soon be choked up with blue sulphate of copper. Possibly this difficulty could be overcome to some extent by lining the con-

ducting tubes and nozzles with lead or tin, although a harder metal would be required for the wearing parts of the pump.

Daisies in Lawns.—At one centre, sulphate of ammonia spray (11 lb. to 3 gal.) was used in order to see if it would destroy daisies. The spray was applied with a "Four Oaks" knapsack sprayer, and it appeared to be quite capable of destroying a very large proportion of the daisies present.

NOTES.

(1) A 4 per cent solution of copper sulphate is generally recommended. See the Ministry's Leaflet No. 63.

(2) "Copper sulphate has no effect upon Corn Crowfoot (Buttercup)" (Worcs.).

(3) "Field trials were carried out (in Worcestershire) on Corn Crowfoot (in autumn-sown corn) against which sulphate of copper is ineffective, and from the results the following is recommended:

Strength: Sulphate of ammonia 1¼ cwt. in 40 gallons of water.
Amount of solution per acre: 60 gallons" (Worcs.).
(This is nearly 2 cwt. in 60 gallons).

If the operation is well carried out in favourable weather at least 75 per cent. of the corn crowfoot will be killed and most of the remainder so damaged that they will have insufficient vigour to produce seed (Worcs.)."

(4) "In the course of spraying experiments with sulphate of ammonia (in Worcestershire) it was discovered that it had injurious effects upon a much wider range of plants than has sulphate of copper. At the above strength and rate per acre it will exterminate almost completely ivy leaved speedwell, large field speedwell and corn spurrey or dither if young (the latter at half strength); charlock, radish, common hemp nettle, and many other annuals are also destroyed to the same extent as corn crowfoot, the spray thus being in the case of these plants not quite so deadly as sulphate of copper. *Peas, beans, vetches and potatoes are all severely injured and clover seedlings are killed. The operation must not therefore be carried out in the case of corn which has been seeded out with clover.*"

(5) As regards the comparative efficacy of sulphate of ammonia and sulphate of copper against charlock the following are the conclusions of the Bangor report:—

(*a*) Spraying Charlock with 4 per cent. sulphate of copper solution is much more effective than with concentrated solution of sulphate of ammonia.

(*b*) The effect of sulphate of copper is more immediate, and, whereas sulphate of ammonia solution only attacks the leaves and to a lesser extent the flowers, sulphate of copper destroys the leaves, flowers and stem.

(*c*) Sulphate of ammonia solution of strengths 2 cwt. or 1½ cwt. to 60 gallons, causes beans to wither.

(*d*) Sulphate of ammonia solution is capable of destroying Charlock if the spraying is done sufficiently thoroughly to cover the whole of the plant. This is not necessary with sulphate of copper spraying.

(e) Spraying with the concentrated solution of sulphate of ammonia causes some of the corn to wither (about 5 per cent. in these observations). Thistles also receive a severe check, their leaves withering completely; they recover in a few weeks, but not sufficiently to mature before harvest.

(6) "As a general rule the growth of corn crowfoot seedlings keeps pace relatively with the corn; in other words, when the season is an early one both weed and crop are forward, while in a late season they are both late. The best period for spraying may consequently be during the latter half of March or the early half of April. The seedlings under these conditions will be about 2 inches high with three or four leaves, thus exposing sufficient surface to catch the spray" (Worcs.).

(7) The Worcestershire report insists on the need for absolute cleanliness of water and vessels used. There must be no risk of foreign matter blocking the sprayer. The spray must be directed so as to hit the plants with force, not merely allowed to drift on to them.

POSSIBILITIES FOR FRUIT GROWING IN THE NORTHERN COUNTIES.

G. P. BERRY,
Ministry of Agriculture.

AN indication of the districts in which fruit growing might be successfully undertaken may be obtained from the geological character of their soils. Starting with the County of Cumberland there is in the Penrith district a Red Sandstone formation which is highly suitable for fruit growing. It is a soil of good substance and produces high colour in small fruits and apples, and the valley of the Eden on this formation presents many aspects which are most suitable for fruit growing The Slate formations of the county are not very suitable for apple growing, although there are favoured spots even on this formation. The Limestone formation extending from Penrith across the county also presents possibilities where the Millstone Grit crops up. On the coal measures in the west of the county, fruit can also be successfully grown, especially on the margins where the coal measure formations meet the Limestone and Sandstone formations; here, as in some southern counties, the blend furnishes an ideal medium loam. Around Carlisle, where the Lias formation meets the Keuper Marl, some excellent fruit-growing soil is produced.

On entering Westmorland the Shale formations predominate, but in many districts the weathering has produced a soil on which fruit can be grown (Westmorland, Damson).

The climate of Cumberland and Westmorland up to 700 and 800 ft. is quite suitable for all classes of small fruits and apples. Travelling eastward into Northumberland across the Limestone formation the Hexham area is reached, and where the Millstone Grit and the Limestone formations meet, as around Hexham, an ideal fruit soil is again produced. This blend extends past Corbridge until the coal formation is again reached, and where these meet as good a fruit soil is again produced. The Millstone Grit and the Boulder Clay then extend up north with the heavier soil on the east and the Millstone Grit on the west, until the Morpeth district is reached. All along this stretch there are unions of these formations producing narrow strips of good fruit-growing soil. When the Morpeth district is passed the Millstone Grit and the Boulder Clay are still side by side as far north as Warkworth. The Limestone formation then appears and this extends right up to the Scottish border. On the lower elevations of the Limestone formation fruit can be successfully grown, provided the necessary shelter can be obtained.

Coming back south into Durham the same formation is continued, viz., the Boulder Clay and the Millstone Grit, and there are portions where a good blend is again met with as at Staindrop, Raby, Barnard Castle, etc. There are also tracts of alluvial soil in the valleys of the Wear and Tees which are suitable for fruit growing.

In Yorkshire the Millstone Grit crops up in pockets amongst the Limestone and produces suitable fruit-growing soils.

Shelter.—This is one of the greatest factors in fruit growing in the northern counties, and in most cases, unless the configuration of the land rules otherwise, shelter is necessary on the north, north-east and east. Much damage is done in the north by the rays of the bright morning sun striking open blossom. Protection from the south-west in summer and autumn is also valuable where fruit is likely to be exposed to strong winds.

In short, although the northern counties cannot be classed as fruit-growing counties in the same sense as Kent, Cambridge, Norfolk, Lincoln, Worcester and Hereford, there are many parts where apples may be successfully grown, and as regards small fruit, results can be obtained superior to those produced in the south. The great drawback to small fruit in the south is the extremes of climate with regard to rainfall. Prolonged droughts occur and ruin the best prospects. These droughts are never so severe in the north, while the night dews are heavier and the general atmosphere more humid.

Varieties.—There have been few varieties of apple, pear or plum introduced in recent years which have been accepted commercially and extensively planted by growers. This is no doubt largely due to the fact that there has hitherto been no means of testing the commercial merits of new introductions, but steps are being taken to remedy this by an endeavour to establish a national testing station where not one tree but a considerable number will be grown under commercial conditions in the open. In the Morpeth and Hexham areas there is urgent need for a commercial experimental plot where varieties of small fruit and apples can be tested and brought to the knowledge of local growers.

At present it is difficult as well as risky to suggest new varieties to growers, but the following should be tried in the north: Apples:—James Grieve (dessert), Roseberry (dessert), Cutler Grieve (dessert); Plum:—Purple Pershore; Pear:—Conference; and Damson:—Aylesbury Prune.

Few of the modern varieties of raspberry, black currant or gooseberry are grown, and the probable reason is the fact that growers are afraid to plant without having seen them tested under local climatic conditions. In the case of gooseberries no district can excel the Wansbeck Valley for quantity and quality. The variety Leveller should be introduced, and it would in all probability furnish a high-class dessert fruit which could be tastefully packed and graded and sold in the popular coast towns in the height of the holiday season on the lines adopted by the Sussex growers in the south coast towns.

Mr. Anderson, the Horticultural Instructor for Cumberland and Westmorland, has found, mainly from plots laid down by the writer over 20 years ago, that the following varieties of apples can be safely planted: Lane's Prince Albert, Bramley's Seedling, Royal Jubilee, Queen, Scotch Bridget, Schoolmaster, Bismarck, Barnack Beauty, and Lord Derby.

The finer quality dessert apples are uncertain in the open, and Cox's Orange Pippin should not be planted north of the latitude of York.

A large local culinary apple known as Royal George is to be found in almost every farm orchard in Cumberland, and is certainly worthy of further consideration on demonstration plots where it might be improved by working on approved types of paradise stock.

In Northumberland, Mr. Mayhew from similar plots has found that apples can be successfully grown even at 1,000 ft. above sea

level. The most suitable varieties are: Domino, Bramley's Seedling, Bismarck, Lane's Prince Albert, Golden Spire and Cox's Pomona. The last-named variety is the best dessert in the open in Northumberland.

Distances to Plant.—The day has passed when the stereotyped distances given in text books should be followed. The distances must be governed by the varieties and the stocks on which they are grown.

Bush Bramley on the paradise requires 18 ft. each way, some others 15 ft. and some of the very weakest 12 ft. Bramley as half or full standards should have at least 40 ft. each way, and there are instances in the south of Bramley meeting after being planted 60 ft. between the rows.

From what we have learned in connection with small men starting fruit holdings, everything points to the necessity of having wide distances between the rows, so as to admit of vegetables or small fruit, and, what is more important, horse and implement cultivation. Moreover, if the fruit grower plants in rows wide apart he can eventually fill up when capital will admit.

All bush trees planted should have a leg of 2 to 2½ ft. to facilitate cultivation and banding.

Pollination.—Although too much importance should not be attached to this subject it has been clearly proved that many varieties of apple do not readily set their blooms with their own pollen, but are dependent on the pollen of some other variety. This being the case it is always safe practice to have three or four varieties in a commercial plantation, and these should be intermixed in preference to being planted in blocks.

Taking all commonly grown varieties of apples, the blooming periods will be found to overlap so that if weather is favourable there is every chance of cross-pollination being effected, and the closer the different varieties are mixed the more likely is pollen to be distributed during brief spells of favourable weather in a season unfavourable for pollination. It is also quite evident from experiments carried out that some varieties produce a more potent pollen than others for cross-fertilisation purposes.

Manuring of Fruit Crops.—Although fruit trees planted on good land may be expected to grow strongly and bear crops of fruit for a period of years there usually comes a time when it is necessary to apply manure. There are many plantations in the country to-day which have come prematurely to a standstill owing to soil exhaustion.

At present there is little reliable information with regard to the manuring of apples.

An extensive experiment was laid down nine years ago at the College garden of the East of Scotland College of Agriculture, Edinburgh, and it was inspected by the writer a short time ago. Some of the plots are most interesting and seem to prove the vital part played by phosphoric acid and potash in fruit production. On the phosphate and potash and on the combined phosphate and potash plots the fruit was larger and better coloured and the crop on the whole heavier as compared with the nitrogen plot.

Where the trees are young and have ceased to grow, some form of nitrogenous, preferably organic, manure must be used. This may be either good farmyard, stable or pig manure. Where none of these is available "shoddy" is probably the best substitute, but even artificials like sulphate of ammonia may be used with advantage. A dressing of 10 tons of good farmyard manure or one ton of shoddy or $1\frac{1}{2}$ cwt. of sulphate of ammonia per acre will help plantations which have ceased to grow.

Where the trees are vigorous and growing but not fruiting heavily 6 cwt. of basic slag of good quality and 2 cwt. of potash salts (20 per cent. K_2O) per acre may be given in autumn. Where the land has sufficient lime the slag may be replaced with advantage by 2 cwt. of steamed bone flour per acre.

As to the best time to apply manure to fruit trees, other than liquid applied while fruit is swelling, there still remains considerable diversity of opinion. The Scottish raspberry experiments and the experience of some expert growers in the south, combined with the general findings of fruit growers under glass, would seem to point to the advantages of autumn manuring as against winter and spring applications. The writer has long been an advocate of manuring in autumn before the leaves have fallen and root action has ceased. This autumn manuring appears to be the only feeding which can influence the formation of fruit buds where such have not already formed, and where they have formed the store of elaborated sap will be increased and a strong healthy bloom secured for the coming season.

Spraying.—The importance of this operation cannot be over emphasised. Upon it is dependent the possibility of producing clean fruit and thus competing with foreign imports. During the late war some pests which were to some extent controlled in pre-

war times multiplied to an enormous extent, notably the winter and March moths.

The most efficacious remedy for all the leaf-eating caterpillars is spraying with arsenates of lead and zinc before the bloom opens and after it has set at the rate of about 1 lb. to 16-20 gallons of water.*

It is also of importance that the trees should be washed with a cleansing wash during the resting period. Many good washes are obtainable, such as standard lime-sulphur, caustic soda and pure lime wash.

The last has many advantages to recommend it. It is readily obtainable and easily made up, the operator can always see where he has sprayed, and there is little danger of missing portions of the trees and bushes. Observations and experiments seem to prove that the later the pure lime spraying is deferred the better the results. Information on spraying is given in the Ministry's Leaflet No. 352 (*The Control of Pests of Fruit Trees in Gardens and small Orchards*).

The lime is washed off by rain later in the season but in many districts it is a valuable addition to the soil and must have a beneficial effect as affording a base where soils are already very acid and in need of lime.

One of the worst enemies of the apple grower of to-day is the capsid bug,† an insect which punctures the fruit at an early stage rendering it unsightly and unsaleable when mature. This insect has already appeared in the north. The only wash which has yet been found of any service against this pest is nicotine and soap and the spray must strike the insect to kill. In the south much harm is being done and the pest is spreading. Successive broods appear and several sprayings are necessary where the pest has once got established.

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TRIALS OF SPRING CABBAGE.

J. C. WALLACE,

Agricultural Institute, Kirton, Boston.

THE growing of spring cabbage for market is a very important industry in the county of Holland (Lincs). The crop is frequently a very profitable one, but occasionally there is a slump in the market, as in the spring of 1920, when many acres were ploughed under in this district.

* See Leaflets Nos. 263, 264.

† See Leaflet No. 319.

Many hundreds of acres are annually grown in the county. Both soil and climate are particularly suitable for spring cabbage, as indeed for all kinds of the Brassica family. The crop is usually a " catch " crop following on after early or second early potatoes, and not infrequently is followed again by potatoes. The crop is not in every case left to mature, or produce hearts, but may, if the field is required for another purpose, be cut and sold as " Greens." There is, fortunately, a demand for this class of cabbage in certain markets.

Spring cabbage growing is fairly well confined to certain districts throughout England, such as the Evesham Valley, Middlesex, and the Holland Division of Lincolnshire. Certain varieties appear to be favoured in different districts. For example, the bulk of the crop in the Holland Division is of the Offenham variety: in other districts other varieties are grown. Many of the large growers in the Holland Division have their own specially selected strains, and grow seed from selected plants each year.

Purpose of the Trials.—There are very many varieties of spring cabbage, many of which would appear to be only strains of well-known varieties, and hardly worthy of a different name. Many of these varieties are inferior from a commercial point of view to well established varieties.

Trials were started in the first place (*a*) to test the hardiness of varieties, (*b*) to compare the yields and earliness of varieties. About 24 varieties were grown, seed being obtained from different districts in England and Scotland, the popular varieties in each district being included.

Cultivation.—A few notes on the cultivation of spring cabbage as carried out in the trials may be of interest.

Date of Sowing.—The varieties reported on were all sown on 23rd July, from which date to the end of July is the usual time for sowing in the Holland district. It is generally acknowledged, however, that in certain other districts spring cabbage must not be sown until August. Generally, it may be said that the earlier the sowing the earlier can the crop be cut, but too early sowing usually tends to a high percentage of " bolting," and it is strongly held in this district that the seed must not be sown before the 23rd July.

The date of sowing may again depend on the variety. Varieties of the York type are never sown in the northern districts until August is well advanced. Rather curiously, how-

ever, sowings of " Leeds Market " made in July and August both showed a tendency to bolt.

Treatment of the Land.—The field used for the trials has the reputation of being a bad one. The previous crop—potatoes—was nearly a failure, but an excellent crop of cabbage was secured. The land was ploughed after the potatoes were lifted and then worked down. Planting was commenced on 28th September and continued for about a week. The plants were put out in rows 2 ft. apart, with 1 ft. 2 in. between the plants. The usual spacing is 1 ft. 6 in. by 9-12 in., but the extra width between the rows was necessary to allow the horse hoe to be used, as the land produced a large amount of chickweed.

All varieties were planted at the same distance apart. The larger sorts, such as Early Market, completely covered the ground at the distance allowed, but the smaller sorts, such as Harbinger and Redbraes Early, did not half cover the ground. Commercially, of course, the more plants that are set out per acre, consistent with securing good cabbage, the more profitable will the crop be. It is not uncommon for plants to be set out 1 ft. by 6 in., but cabbages of good size are rarely obtained, the crop being cut when half hearted.

Manuring.—No farmyard manure was applied to the cabbage crop. Soot, at the rate of half a ton per acre, was applied in December and 2 cwt. of nitrate of soda was given at intervals from the middle of January, ½ cwt. per acre being applied at each dressing. This appeared ample for the crop, as it finished particularly well. The amount of organic matter in the field was, however, very high.

Hardiness of Varieties.—It was thought that the district in which the seed was saved might have an influence on the hardiness of varieties. As previously mentioned, seed was therefore obtained from different districts. No difference was, however, noted in the hardiness of the varieties grown. The winter of 1920-21 was very mild, only one short spell of frost occurring in December. This frost was very severe, and may have been the cause of the high percentage of " bolting " which occurred in certain varieties. Recurring frosts and thaws would no doubt destroy more plants than a continued severe frost, but severe frost might cause " bolting."

The percentage of " bolting " is given in the table at the end of this article. Further trials are being carried out to test varieties for hardiness.

Earliness.—The date on which the different varieties were ready for cutting is shown in the table. It will be noticed that there is a very considerable difference in the dates of cutting.

The earliest varieties were April, Harbinger and Redbraes Early. These were first cut on 29th March. The bulk, however, of April was several days later than the other two varieties. Early hearting is of great importance for the first cuttings, as prices usually run high at the beginning of the season. It has been mentioned that Offenham is the popular variety in the Holland area. In the trials Offenham and varieties of the Offenham type were generally three weeks later than the varieties mentioned.

A considerable amount of further investigation is here required. For instance, in the first place has the district in which the seed is saved any influence on the resultant crop. Again, supposing seed of the same variety was obtained from different districts, the question of selection comes in. There is undoubtedly a very great difference in the strains of any variety. It would almost appear to be necessary to select one's own strain, and send the seed to different districts to be grown, the seed then being returned here for trial.

Yield per Acre.—The yields per acre are not given, as many of the dwarf sorts should have been planted closer. Any figures given therefore would not convey a true idea of the possible yields per acre. Useful information may, however, be obtained from a comparison of the weight and number required to fill a pot or net.

Remarks on Certain Varieties.—*Flower of Spring.*—This variety behaved very badly in the trials. It hearted very late, and the hearts when formed were not solid, although it is usually reckoned as being very early in hearting, and very free from "bolting." It produced abundant foliage in the late autumn and early spring, and could have been cleared as "Greens" at the end of January. Messrs. Sutton say they have never known this variety to bolt to any extent, nor have they known it to heart so late, and I have myself usually found this variety, when true to name, to throw very few "bolters." It is, however, noteworthy that seed of Flower of Spring obtained from another source and sown a month later behaved in exactly the same way as the earlier sowing. The behaviour of this variety is being watched with interest in the 1922 trials.

Harbinger and Redbraes Early.—These varieties are very dwarf, the latter being much smaller than the former. If plants were put out very close together an early and heavy crop would be obtained.

Large Early Market.—One of the best mid-season varieties, producing large solid hearts. Sixteen to eighteen cabbages filled a pot.

McEwan's Early.—This old variety was also one of the outstanding varieties. It was cut about the same time as Large Early Market. The hearts are not so large but more solid, and the colour is very good. Most of the growers who visited the trials were struck with the excellent appearance of this very old variety.

Offenham.—Several strains of this variety were grown. One strain obtained from a private grower in Evesham was a long way ahead of the others. The importance of getting a proper strain cannot be too strongly emphasised.

Mein's No. 1.—This variety is an old one. It produced good plants early in the year, and at one time gave promise of being amongst the best. It did not, however, heart up as well nor as early as expected. It would probably be a good variety for cutting as "Greens."

Varieties of the York Type.—Varieties of this type such as Leeds Market, would not appear suitable for this district. They are sown in the northern districts in August for hearting in early summer.

Other Varieties.—A number of varieties were omitted from the first sowing, owing to lack of room. Of these Wheeler's Imperial, Market Garden, and Early Wonder may be mentioned as showing promise. They produce small solid hearts. Not being included in the first sowing they were not tested for earliness.

Varieties for Cutting as "Greens."—There is a considerable trade for young half-hearted cabbage in the early spring, and frequently fields are set out for cutting for this purpose. Plants are set out very close together, and the field can be cleared early in the year, in order to prepare for another crop. Varieties required for this purpose must produce a large amount of foliage, yet must not be too loose growing.

Mein's No. 1 and Leeds Market might be suitable for this purpose. Flower of Spring, if it behaves in further trials as it did in 1921, would also be suitable. Leeds Market is of the

York type, and throws rather elongated open foliage. Further tests, however, are being made.

Variety.	District in which Seed was saved.	When Cut.	Percentage of "Bolters." per cent.	Average weight per Net or Pot. lb.	Average No. per Net or Pot.
Flower of Spring ...	Essex ...	28th April...	60	—	—
April	Essex ...	29th March	—	40	30
Harbinger	Essex ...	29th March	—	40	32
Favourite	Essex ...	6th April ...	5	42	27
Edinburgh Market ...	Lothians ...	6th April ...	2	42	24
Market	Middlesex...	18th April...	—	40	22
Large Early	Lothians ...	18th April...	—	56	17
McEwan's Early ...	Lothians ...	19th April...	—	48	24
Redbraes Early ...	Lothians ...	29th March	—	40	33
Early Feltham ...	Middlesex...	20th April...	5	49	24
Offenham	Middlesex...	21st April...	—	48	27
Mein's No. 1... ...	— ...	21st April...	5	45	24
Knowefield Early ...	— ...	21st April...	10	48	24
Ellam's Early ...	Lincs ...	21st April...	5	48	25
Manchester Express...	Essex ...	21st April...	—	42	27
Smithfield Market ...	Essex ...	26th April...	10	45	23
Leeds Market ...	Essex ...	3rd May ...	90	—	—
Offenham	Evesham ...	26th April...	—	52	22

The remaining varieties were sown later, and were kept back owing to a fall in market prices. As a result of the dry weather they finished badly, and are not reported on here.

It is exceedingly difficult to lay down anything very definite as the result of one year's trials. It is hoped that these trials will be continued on a commercial scale over a number of years. As a result of the first season's trials many problems have arisen. In addition to the main commercial results, such as yields and earliness, there are other points which require investigation, such as those mentioned in the paragraph on earliness.

POTATO PINK ROT: A DISEASE NEW TO ENGLAND.

A. D. COTTON,

Mycologist, Pathological Laboratory, Ministry of Agriculture, Harpenden.

THE discovery in England of the disease known as Pink Rot adds another name to the already lengthy list of fungus diseases which attack potatoes in this country. Pink Rot was until recently known only in Ireland where, by destroying the tubers, it is capable of inflicting very considerable damage to the crop. The disease and the parasite causing it were described in detail

by Dr. G. H. Pethybridge in 1913.* About two years ago it was detected in Scotland; and during the summer of 1921 outbreaks were discovered at two centres in England.

The fact that Pink Rot was discovered last season does not necessarily imply that the disease then occurred in England for the first time. It is certain that it is not present in the country to any serious extent, but it is equally possible that the wilted tops of plants affected by Pink Rot may have been mistaken for the effects of Blight and that the rotted tubers may have been regarded as due to Blackleg or bacterial decay as the result of some form of mechanical injury. The discovery and prompt identification of the disease is gratifying to this extent, that it shows on the one hand the efficiency of the Ministry's Inspectors in detecting new or rare diseases in the course of their manifold duties, and on the other the keenness of farmers to be fully informed and their wisdom in seeking expert assistance.

The Disease in England.—In addition to the two field outbreaks referred to, a case of Pink Rot detected in England in seed potatoes may first be noted. Seed of the variety Majestic obtained from Scotland was observed by Mr. W. Buddin, the Adviser in Mycology at University College, Reading, to be showing suspicious symptoms. Laboratory examination revealed the presence in the tubers of mycelium characteristic of the group of the Phycomycetes. The fungus was grown in artificial culture, isolated from other organisms, and was identified by means of the characteristic and unusual resting spores as being *Phytophthora erythroseptica*, the fungus causing Pink Rot. Only a very few tubers were affected, the remainder of the bulk being perfectly sound. This was the first occasion on which the Pink Rot fungus has been recognised in this country, and a potential outbreak was averted. A notice as to the disease was circulated to the advisers and inspectors, and various samples of suspicious seed-tubers were subsequently submitted to the Ministry's Plant Pathology Laboratory at Harpenden for expert examination; but these all proved to be suffering from frost or other non-parasitic form of injury.

The next report as to Pink Rot was received at the Laboratory from Mr. J. Jarrett, an inspector stationed at Wellington, Salop, who forwarded several samples of completely rotted tubers from

* On the Rotting of Potato Tubers by a new species of *Phytophthora* : *Sci. Proc. Roy. Dub. Soc.*, xiii (N.S.); 35, p. 529.). Further Observations on *Phythopthora erythroseptica*, Pethyb.: *Ib.*, xiv (N.S.); 10, p. 179. Also in *Journ. Dept. Agr. and Tech. Instr. for Ireland*, Vol. XIII, No. 3, April, 1913. Investigations on Potato Diseases (Fourth Report.)

that county. The fungus when isolated and cultivated developed resting spores of *P. erythroseptica* in the typical manner, thus confirming the Inspector's diagnosis in the field. The variety in this case was Great Scot grown from Scotch seed. The disease was first detected on 22nd August, about five per cent. of the plants in a five-acre field being affected. It was observed to be worse in some parts of the field, especially the low-lying portions. A careful survey of the neighbouring district was made by Mr. Jarrett and the disease was found to be present to a small extent in a number of fields in several of the adjoining towns and villages. In all, six localities were discovered, the variety in each case being Great Scot, the seed being obtained from Scotland. Local opinion indicates that there is some ground for believing the disease to have been present in previous seasons in these districts and that it was not introduced in 1921 with Scotch seed. On the other hand the fact that Great Scot only was affected is rather against this view.

The other case occurred near Stevenage, in Hertfordshire, specimens being submitted by a farmer. The variety was King Edward and was grown on land which had not been under potatoes for five years. The seed was home-saved and the crop during 1920 showed no signs whatever of Pink Rot. The seed therefore was almost certainly not the means by which the disease was introduced. Its origin, however, is probably easy to account for. The field in question had been heavily dressed with "London manure." This contained a large amount of vegetable debris such as cabbage stalks, banana stalks, onion, orange and potato refuse, indicating that the manure was contaminated with street sweepings or even market refuse. There can be little doubt that in this case the disease was introduced with the manure, which contained resting spores of Pink Rot in potato peelings and possibly even diseased potatoes which had been thrown out on account of being rotten. The Stevenage case appeared to be an isolated one, no other affected fields being observed in the neighbourhood. The field in question was three acres in extent, the disease occurring in patches; in the worst parts thirty-five per cent. of the plants were affected. The tops of the diseased plants died down early and every tuber on the roots was completely rotted with a moist rot.

Description of the Disease.—The fungus causes a wilting of the haulm and a moist rot of the tubers, the disease deriving its

popular name from the fact that the cut surfaces of infected tubers quickly turn pink when exposed to the air. It commences when the potatoes are still in the ground and attached to the parent plant, and has been found from the end of July onwards. In most cases the attack in the tuber begins at the heel end, because the fungus enters through the stalk, and it proceeds rather rapidly towards the rose end. Diseased tubers remain firm, but of an india-rubbery consistency, and if pressed exude a quantity of juice, while finally they become completely rotten. They do not, however, develop cavities, as in the case of Blackleg. A characteristic series of colour-changes takes place when affected tubers are cut open and exposed to the air and these form an important character for diagnosing the disease in the field. *A pink colour begins to show a few minutes after cutting, and within half-an-hour the whole of the diseased portion becomes a deep salmon-pink. With an exposure of several hours the cut surface gradually darkens and becomes purplish-brown or nearly black.*

Plants infected with the Pink Rot fungus show also indications of unhealthiness in the foliage, due to the presence of mycelium in the stem and roots. This usually occurs rather late in the season. The leaves become pale green or yellow and ultimately collapse or fall off. The symptoms are on the whole those of a Wilt, though the denuded stem somewhat resembles those which have been severely attacked by Blight. Resting spores of the fungus are found in the underground stems and also in old diseased tubers, and in this way the contamination of the soil is brought about.

The losses caused in some of the western districts of Ireland by Pink Rot may be very considerable, in some cases heavier even than those due to Blight, and are greatest in crops grown continuously or too frequently on the same land.

Conclusion.—The discovery of Pink Rot need not alarm English growers. As stated above, it is probably not an absolutely new introduction, but has now been detected for the first time. Its discovery is, however, of great importance, since if the view be correct that Pink Rot has existed in the country for several years and been regarded as Blight, it is obvious that spraying as a preventive would be a waste of time and money. In Ireland it has been known now for many years but has apparently not spread to any extent, and with proper rotation of crops, care as to seed and precautions as to the use of town

manure highly contaminated with vegetable refuse there is no reason to expect further serious outbreaks. Where Pink Rot has occurred diseased haulms and tubers should on no account be left lying about and especially not allowed to reach the manure heap.

Irish and Scotch growers should take steps to eliminate the disease as far as possible, both from seed and ware crops. The great lesson to be learned is the importance of accurate knowledge with regard to all these diseases both on the part of those whose duty it is to undertake research and of those who grow the crops. Any doubtful cases of this or other diseases will be reported on if specimens are sent either to the Adviser in Plant Pathology at the local Agricultural College or to the Ministry's Pathological Laboratory at Harpenden.

THE TURNIP GALL WEEVIL.

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THE turnip gall weevil (*Ceuthorrhynchus pleurostigma*, Marsh.) is a small beetle injurious to turnips and cabbages, being the cause of the smooth rounded outgrowths, known as galls, on these plants. The galls are the abode of the young of these insects. These bear no resemblance to their parents and are known as grubs or larvæ. The insect is distributed throughout the United Kingdom and is also found on the Continent.

Description and Habits.—The weevil is about ⅛ in. in length, and is black above and greyish below. During summer and autumn they may be seen in numbers, but one has to look for them carefully as, in addition to being very small, they always attempt to remain concealed and when disturbed drop into the soil and lie motionless on their backs. They generally feed on the leaves, tender bark, young pods and flowers of turnips and cabbages, and the foliage and flowers of charlock and hedge mustard. They rarely expose themselves and are usually found on the lower surface of the leaves of the plants mentioned above or in the soil at or close to the roots of the plants in the roots of which they lay their eggs.

The egg is a very minute, soft, almost transparent object, and is laid in a cavity drilled by the parent beetle in the bark on the root of the host plant, *see* Fig. 2. One female beetle lays

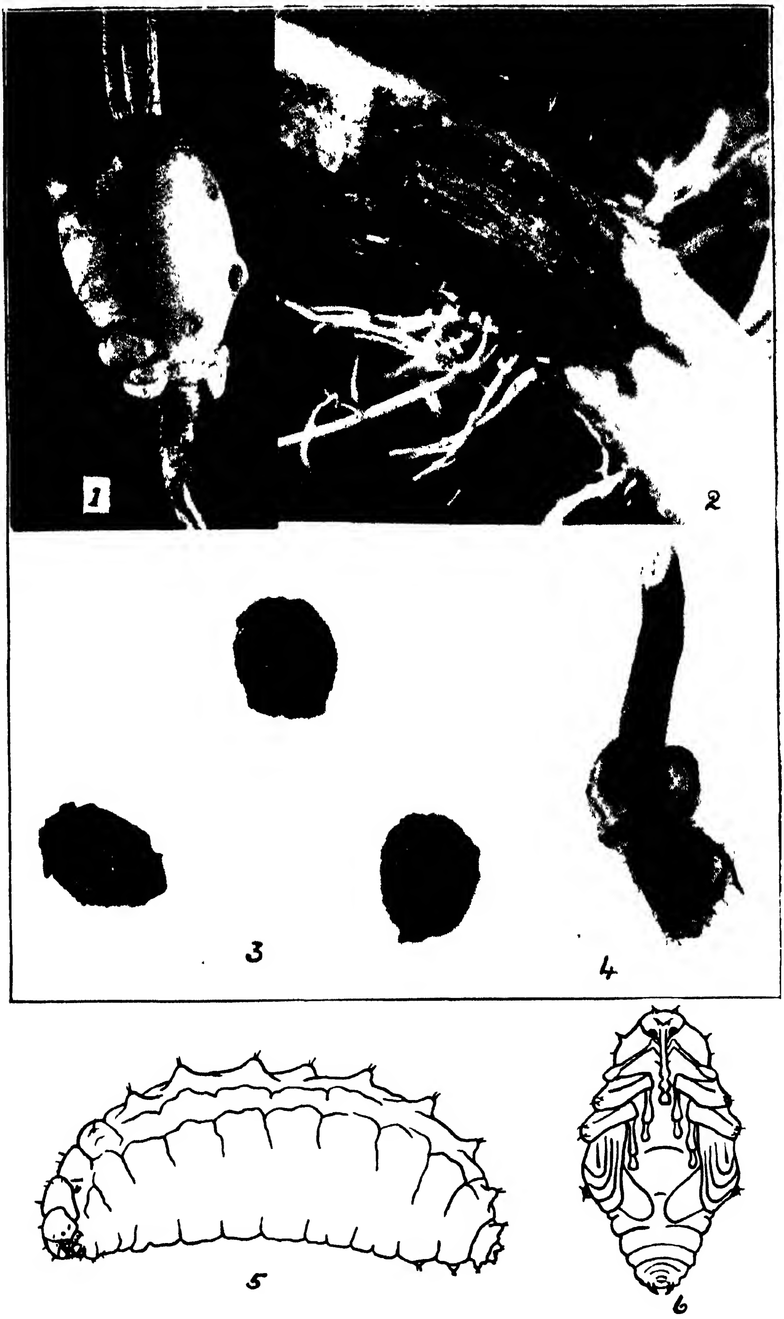

FIG. 1.—Turnip with galls caused by the Gall Weevil (reduced).
2.- Two Weevil Eggs in bark of cabbage stem, indicated by arrow marks, exposed partly removing the bark (enlarged).
3.—Cocoons made by the Weevil Larvæ for pupation (enlarged).
4.—Galls on cabbage root showing round exit holes of the Larvæ (reduced)
5 Full-grown Larva of the Gall Weevil (greatly enlarged).
6.- Pupa of the Gall Weevil, ventral view (greatly enlarged).

about one to four eggs per day and may lay a total of about sixty eggs, visiting a number of plants for the purpose.

In a few days the egg hatches and a small legless grub, with a hardened head capsule provided with jaws, comes out. It begins to feed on the inner bark and the plant reacts by growing the knob-like gall around it. The head of the larva is brownish and the body, which is usually held arched in the form of a crescent, is whitish, but may appear yellowish in those that occur in swedes.

When this grub is full-grown (Fig. 5) it bores its way out of the gall through a small round hole (Fig. 4), and goes into the soil. With the aid of a gummy liquid which it produces it then makes a small mud cell (Fig. 3), and transforms inside it into a pupa. These mud cells, known as cocoons, are found among the roots within a depth of about 4 in.

The pupa inside the cocoon (Fig. 6) is the stage in the life-history of the insect when the grub is developing the organs and structures of the adult beetle. When the pupal period is over, the weevil appears, and forcing the cocoon open, finds its way out.

Two Races of the Weevils.—There are two races of these beetles, each producing one brood during the year. One appears in spring and breeds mostly in charlock. The parents die off by summer and the young turn into beetles by August; these adults do not lay eggs at once, but hibernate during the winter and breed in the next spring. This race is not of much economic importance.

The other race, which may be called the summer race, appears in early summer and lays eggs in cultivated crucifers (cabbage, turnips, etc.) of various sorts and dies off by winter. The eggs soon hatch into grubs and these remain in the galls during the winter and pupate in spring. This race is of great importance to the farmer.

Life-History of the Weevils of the Summer Race.—The parent beetles make their appearance about the beginning of June, lay eggs from the end of August throughout autumn, and die off in winter. Turnips in all stages and other plants about six weeks old are preferred for laying eggs in. The eggs hatch in five days or more according to the weather conditions, longer periods being necessary if it is cold. The larvæ in various stages hibernate in the galls during winter, resume feeding in spring, and throughout March and April and one after another leave the galls and pupate. The full-fed larvæ do not bore

out of the gall to pupate except after the soil around has been well moistened by rains. About five to six months are spent in the larval stage. The pupal period varies and is short for those that cocoon late owing to the warmer conditions. The adults emerge late in May or early in June.

Host Plants.—The cultivated plants known to be attacked include turnip, mustard, rape, cabbage, Brussels sprouts, cauliflower, kale, and kohl-rabi.

Natural Enemies.—This insect has various natural enemies. The common garden slug may bore into the galls and feed on the grubs along with the plant tissues. The grub of the turnip mud beetle (*Helophorus rugosus*, Ol.) preys on the weevil larvae and will bore into the galls to get at them. A small parasitic wasp (*Diospilus oleraceus*, Hal.) lays its egg through the gall into the grub and its larva lives inside it, ultimately killing it. Certain birds pick the grubs out of the galls and feed on them.

Methods of Control.—(1) Root out all infested stalks that have been wintered over by the beginning of March, and of spring cabbages as early as possible, and immediately stack them up in large loose heaps. This is the time when the grubs are nearly full-grown and begin to bore out into the soil to pupate. They go into the soil, however, only when it is quite moist and by stacking the stems as advised above the full-grown larvæ are kept back in the first place and as the bark dries quickly they find it impossible to bite through the hard bark to go into the soil. The rest are half grown larvæ and these slowly shrivel up in the bark as it dries. Never leave infested stalks in small lots or scattered about for any length of time.

(2) Plough the land deeply immediately the infested crop has been removed. This operation will crush and destroy numbers of cocoons with the pupæ within. This is very necessary where such crops could not be removed at the early date suggested.

(3) Avoid in the next autumn planting another crop that is likely to be attacked. The summer race lays its eggs from about the end of August through the autumn.

(4) Destroy all charlock and hedge-mustard, as the adult weevils feed on these, and as it may be possible that some of the beetles emerging early from the spring race that breeds in charlock may lay eggs in the cultivated plants in autumn.

THE FOOD AND FEEDING HABITS OF THE LITTLE OWL.

II.

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EXPERIENCE has shown that in order to arrive at a thorough understanding of the food of any species of wild bird it is necessary to examine the stomach, etc., contents of a large number of individuals, obtained from many localities, and throughout the various months of the year. Prolonged and numerous investigations have convinced the writer that the most reliable method of estimating the different food items is that known as the volumetric system or percentage by volume.

Moreover, such mehods of investigation must be supplemented by field observations, the examination of pellets (where present), the faeces (when necessary), and the food fed to the nestlings.

In the present investigation 212 stomachs of adult birds have been examined from 19 different counties and 23 separate localities. Two of the stomachs were empty and 16 were nearly empty or only partially filled. These are therefore not included, the net number being 194. Of nestlings 18 specimens have been examined and upwards of 260 pellets, while numerous observations have been made on the "hoards" and food brought to the nest.

The counties involved were:—

Bedford.	Kent.	Suffolk.
Bucks.	Leicester.	Surrey.
Devon.	Lincoln.	Sussex.
Dorset.	Norfolk.	Wilts.
Essex.	Northampton.	Yorks.
Hereford.	Notts.	
Herts.	Somerset.	

The number of adult Little Owls examined in this investigation, and the months in which collected, were as follows:—

Jan.	Feb.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.	Total
18	20	21	26	27	22	14	7	0	10	14	15	194

Food of the Adult.—*Animal Food.*—Of the total bulk of food consumed annually by the Little Owls examined 93.49 per cent. consisted of animal matter. The greatest proportion was consumed in November (98.22 per cent.) and the smallest pro-

Monthly percentages of the Principal Food Items of the adult Little Owl.

Kind of Food.	Jan.	Feb.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
Seeds of Weeds	—	—	—	—	—	1·45	1·07	3·57	—	—	—	—	·55
Miscel. veg. matter ...	11·11	8·00	3·81	5·26	4·33	4·64	6·43	8·58	—	5·50	1·78	6·13	5·96
Slugs	—	—	—	—	—	—	—	—	—	·20	—	—	·02
Injurious Insects	30·78	20·25	43·00	36·92	38·52	26·82	40·36	20·00	—	29·00	19·29	31·87	30·62
Beneficial „	4·55	—	·25	—	3·90	·14	—	·28	—	—	1·43	·33	·99
Neutral „	9·67	28·50	11·52	12·12	14·07	17·41	17·50	19·28	—	26·00	22·14	15·67	17·63
Voles and Mice	31·67	27·75	25·24	26·73	29·25	33·64	19·29	32·14	—	29·30	50·72	35·86	31·05
Wild Birds	8·61	3·00	9·28	5·39	4·63	5·00	2·50	2·86	—	5·00	—	2·67	4·45
Game Birds	—	—	—	—	—	5·59	—	—	—	—	—	—	·51
Earthworms	3·61	11·25	6·20	13·20	5·00	4·50	12·50	12·86	—	5·00	4·64	7·47	7·83
Millipedes, &c.	—	—	—	—	—	·36	·35	·43	—	—	—	—	·11
Miscel. animal matter ..	—	1·25	·70	·38	·30	·45	—	—	—	—	—	—	·28
Totals	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

portion in August (87.85 per cent.). The seasonal variation, however, in diet was much less than in the case of most land birds. (*See* table p. 1184.)

Mammals.—Remains of mammals were found during each month, and in 126 stomachs. The highest percentage occurred in November (50·72 per cent.) and the lowest percentage in July (19·29 per cent.). The long-tailed Field Mouse (*Apodemus sylvaticus*) was by far the commonest species met with, remains being present in no less than 86 stomachs. Remains of the Short-tailed Field Mouse (*Microtus hirtus*) were found in 50 stomachs, the House Mouse (*Mus musculus*) in 9 stomachs, the Brown Rat (*Epimys norvegicus*) in 3, the Red or Bank Vole (*Evotomys glareolus*) in 2, the Common Shrew (*Sorex araneus*) in 3, and the Mole (*Talpa europaea*) in 4.

Birds.—Remains of wild birds were found in 35 stomachs. The total average percentage of wild birds is 4·45 per cent., and of game birds ·51 per cent. The highest percentage was found in March (9·28 per cent.) and the lowest in December (2.67 per cent.). The percentages for the different species are as follows :—

House Sparrow	2·09	per cent.
Starling	2·04	,,
Missel Thrush	·12	,,
Blackbird	·07	,,
Wood Pigeon	·09	,,
Game Birds	·51	,,
Miscellaneous	·04	,,

Reptiles and Amphibians.—Remains of the Common Frog (*Rana temporaria*) were found in two stomachs.

Insects.—Insect food constitutes 49·24 per cent. of the total bulk of food for the year and occurred in 179 stomachs. Examined month by month, the maximum quantity is seen to be taken in July, viz., 57·86 per cent. In August it falls to 39·56 per cent., the lowest for any month in the year.

An analysis of the insect food presents many points of interest. Firstly, of the total average percentage 30·62 per cent. consists of injurious insects and their larvae, ·99 per cent. of beneficial insects and 17·63 per cent. of neutral insects and their larvae. Wireworms and click beetles constitute 16·88 per cent., and are present in all the months of the year. The highest percentage is in March (30·00 per cent.) and the lowest in August 6·57. Weevils or snout beetles form 9·96 per cent. of the total food contents and are taken in the greatest quantity in May (19·59 per cent.), and in the smallest quantity in November (2·50 per cent.). Of the neutral insects the bulk consists of Dung Beetles (*Geotrupes*).

Molluscs.—Remains of the Grey Field Slug (*Agriolimax agrestis*, L.) were found in a stomach in October. This was the only mollusc observed.

Crustacea.—The only traces of Crustacea were those of woodlice, remains of *Porcellio scaber* being found in three stomachs and *Oniscus asellus* in one.

Annelida.—The only annelids that could be identified were earthworms The total average was 7·83 per cent. The highest monthly was 13·20 per cent. in April and the lowest 3·61 in January.

Vegetable Food.—Of the total bulk of food consumed in the year vegetable matter constitutes 6.51 per cent. This consisted chiefly of grass and bits of leaves and .55 per cent. of weed seeds.

Food of Nestlings.—Only 18 stomachs of nestlings were examined. They are, however, of great importance in that they show that the actual amount of insect food is lower than during any other period. The young birds do not seem to be able to deal with beetles, but beetle larvæ and earthworms constitute 18 and 23 per cent. of the food during this period. Voles and mice form 49 per cent., wild birds 10 per cent., and game birds nil.

Examination of Pellets.—Large numbers of pellets (267) from all parts of England were examined. The average weight is 60 grains. They consist almost entirely of animal remains. Of the total bulk 53.5 per cent. consists of voles and mice, insect remains form 41 per cent., of which 17.8 per cent. are of injurious insects, 2.2 per cent. of beneficial insects, and 21 per cent. of neutral species. Young birds are represented by 2.5 per cent. and miscellaneous and unidentified animal matter by 3 per cent. In none of the pellets were any traces of game birds found.

Variation of the Food according to Season.—Even supposing all the charges relative to the destruction of young game birds were true, it is obvious that such food is only available for a comparatively short season of the year. It is therefore important that we should know the exact nature of the food throughout the whole year.

The seasonal variation in diet is much less in the Little Owl than in most land birds, and remains of game birds were only found in two cases and both of these accurred in the month of June. Indeed, of the two specimens one had been fed by the keeper with dead pheasant chicks.

Mammals, injurious and neutral insects and earthworms were found throughout the year, as also a small quantity of vegetable matter.

Variation of the Food according to Locality.—The following table sufficiently explains itself, as showing considerable variations in the food taken by the Little Owl in all the counties involved :—

Relation of Localities and the Number of Stomachs containing Injurious Insects, Voles and Mice, Wild Birds and Game Birds.

County.	No. of Stomachs containing Injurious Insects.	Percentage.	No. of Stomachs containing Voles and Mice.	Percentage.	No. of Stomachs containing Wild Birds	Percentage.	No. of Stomachs containing Game Birds.	Percentage.	Total No. of Stomachs examined.
Bedford ...	11	38·20	7	22·66	3	3·33	—	—	15
Bucks	5	38·00	3	24·00	2	12·00	1	5·00	5
Devon	9	39·42	7	28·75	2	1·25	—	—	12
Dorset	13	41·20	10	26·33	4	3.66	—	—	15
Essex	9	30·83	7	25·00	3	5·42	—	—	12
Hereford ..	1	70· 0	—	—	—	—	—	-	1
Herts	6	36·66	5	18·88	1	2·77	—	-	9
Kent	7	27·50	5	21·50	1	4·50	—	—	10
Leicester ...	7	25·00	6	22·73	1	·91	1	8·91	11
Lincoln ...	8	23 33	12	43·00	—	—	—	—	15
Norfolk... ...	5	35·00	5	26·26	2	8·33	—	—	6
Northampton ...	9	43·33	8	27·92	2	2·92	—	—	12
Nottingham ...	6	32·50	6	30·62	3	11·25	-	–	8
Somerset ...	9	26·66	7	9·66	5	13·00		-	15
Suffolk	4	17·86	7	54 71	—	—	--	--	7
Surrey	7	25·42	6	32·75	3	15·42	--	—	12
Sussex	—	--	—	—	—	—	–	-	1
Wilts	8	35·60	7	30·50	1	2·00		—	10
Yorks	12	21·94	18	51·44	2	1·39	-	--	18
	136		126		35		2		194

The following statement shows the great variety of Animal Food identified in the stomachs and pellets of the Little Owl :—

Annelida :—
Earthworms (various species).

Arthropoda :—
ISOPODA—
Oniscus asellus, L.
Porcellio scaber, Latr.
MYRIAPODA—
Polydesmus, sp.
INSECTS—
Unidentified insect fragments.
Orthoptera.
Earwig.
Coleoptera.
Unidentified larvae.
Carabus violaceus, L.
Harpalus, sp.
Pterostichus madidus, Fabr.
Pterostichus, sp.
Ocypus olens, Mull.
Philonthus, sp.
Silpha opaca, L.
Aphodius fimetarius, L.
Aphodius, sp.
Geotrupes stercorarius, L.
Rhizotrogus solstitialis, L.
Melolontha vulgaris, Fabr.
Phyllopertha horticola, L.
Elater, sp.
Athous niger, L.

INSECTS—*Contd.*
Athous, sp.
Agriotes sputator, L.
Agriotes obscurus, L.
Agriotes lineatus, L.
Apion, sp.
Otiorhynchus picipes, Fabr.
Otiorhynchus tenebricosus, Herbst.
Otiorhynchus sulcatus, Fabr.
Sitones, sp.
Ceuthorhynchus, sp.
Hylobius abietis, Fabr.
Scolytus, sp.
Hylesinus fraxini, Pz.
Lepidoptera.
Hepialus lupulinus, L.
Hybernia defoliaria, L.
Cheimatobia brumata, L.
Mamestra brassicae, L.
Agrotis segetum, Schiff.
,, *exclamationis*, L.
Triphaena pronuba, L.
Tortrix viridana, L.
Diptera.
Tipula oleracea, L.
,, *paludosa*.
Pachyrhina maculosa, Meign.
Hymenoptera.
Nematus, sp.

Amphibia :—
Rana temporaria.

Aves :—
House-Sparrow.
Starling.
Blackbird.
Missel Thrush.
Chaffinch.
Greenfinch.
Skylark.
Wood Pigeon.
Pheasant.

Mammalia :—
Short-tailed Field Vole (*Microtus hirtus*).
Red or Bank Vole (*Evotomys glareolus*).
Brown Rat (*Epimys norvegicus*).
House Mouse (*Mus Musculus*).
Long-tailed Field Mouse (*Apodemus sylvaticus*).
Common Shrew (*Sorex araneus*).
Mole (*Talpa europaea*).

Summary and Conclusion.—After a very thorough and exhaustive investigation extending over three successive years, and after examining the stomach contents of 194 specimens of adult Little Owls and 18 nestlings, in addition to making careful examinations and analyses of 267 pellets and many "hoards," the author has come to the following conclusions :—

The results obtained by this investigation clearly show, as previously pointed out by Gurney (10) that the losses occasioned to game birds have been grossly exaggerated, and while there is no desire to minimise such in any way, it is urged that the relative seriousness should be clearly understood.

Young game birds are not available as an article of food except for a comparatively short season of the year; moreover, game birds are not bred in every county.

Gamekeepers and others have been appealed to to send in specimens of the Little Owl, and they have very willingly responded, but in spite of the closest and most minute scrutiny to which the stomach contents have been subjected, the percentage of remains of game birds is infinitesimal. Injurious and neutral insects and voles and mice constitute the main items of food.

An examination of 18 stomachs of nestlings gives similar results, while that of the pellets and larders, both by the writer and others, lends no support to the view that large quantities of game birds are destroyed. It is not stated that the Little Owl does not destroy young game birds, for it does, but it is contended that the actual percentage is so small that it is, under ordinary circumstances, negligible. There are no doubt cases where the depredations of a few birds are serious, and of course in such circumstances they should be destroyed.

In consequence of the cumulative evidence obtained we are forced to the only logical conclusion, viz., that whilst a few young game birds are destroyed, the bulk of the food of the

Little Owl consists of injurious and neutral insects, and voles and mice. There is no escape from the conclusion, for it is corroborated and borne out by an examination of upwards of 260 pellets, the stomach contents of 18 nestlings and numerous field observations. Moreover, quite a number of gamekeepers state that they have never seen this bird attack game birds, although living in close proximity to them.

Respecting the value to the agriculturist there cannot, in the writer's view, be any doubt. In sixteen years' experience he knows of no bird (other than the Lapwing) which destroys so large a percentage of click beetles and wireworms. A bird that feeds largely upon wireworms and click beetles by day and voles and mice by night is surely worthy of protection. Even supposing that this bird became much more destructive to game birds than at present, its value to the agriculturist would still more than compensate for the injury.

It is patent to any unprejudiced mind that any policy of destruction is robbing the farmer of a most valuable aid in the destruction of farm vermin and some of the most troublesome crop pests, and it is sincerely to be hoped that they will raise their protest against any such inimical action.

In carrying out this work I have placed myself under many obligations. Firstly I wish to acknowledge the financial assistance given me by the Carnegie Trust for the Universities of Scotland, who have defrayed the major portion of the expenses of this investigation.

I wish to record my thanks to the Editors of the *Field*, the *Gamekeeper*, and the *Shooting Times*, for the wide publicity they have given to this investigation, without which I should have failed to obtain the bulk of material examined. Finally, to the following ladies and gentlemen I am indebted for a constant supply of specimens, pellets and observations and information relating to this species :—

Miss C. M. Acland, Fred S. Beveridge, Esq., William C. Blake, Esq., A. H. Burge, Esq., the Rev. R. B. Caton, W. M. Christy, Esq., W. Cooke, Esq., H. J. Fordham, Esq., Charles T. Freeman, Esq., the Rt. Hon. Viscount Harcourt, W. Hugh Huttley, Esq., Robert Jardine, Esq., J. E. Knight, Esq., the Rt. Hon. Viscount Knutsford, Noel T. Lloyd, Esq., R. B. Lodge, Esq., Capt. W. S. Medlicott, E. G. B. Meade-Waldo, Esq., Dr. F. G. Penrose, Major H. O. Peacock, A. H. Batten Pooll, Esq., A. L. Sadler, Esq., the Rev. Julian G. Tuck, D. Milne Watson, Esq., C. E. Wright, Esq., and to numerous gamekeepers throughout the country.

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NOTES ON MANURES FOR MARCH.

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Manure for the Swede Crop.—Few crops have been so much discussed as the swede crop: on many farms it involves the expenditure of more money per acre than any other, and at the same time it is so useful as to justify attempts to secure as large a yield as possible. On good farms the management of the crop is as a rule so satisfactory that the yield is about as high as the season will allow: in other words, the limit is set by the weather rather than by the farmer's efforts. Indeed, in some parts of the country farmers put on more fertiliser to the swedes than the yields justify, thus not only bringing disappointment on themselves but losing the benefit which

might have accrued had the fertiliser been used for some more responsive crop. This matter has been tested by Professor Somerville, and his conclusions are justified by the later Rothamsted work. These experiments show that if the yield of swedes does not run to more than about 15 tons per acre there is no advantage in using both dung and artificials: a farmer may use dung if he can spare it, and then his artificials could go on to some other crop: or, if he could make better use of his dung somewhere else, he could grow his swedes on artificials only, except where the soil is likely to dry out. This is shown in an experiment made at Rothamsted in 1915, when the yields per acre were:—

No manure.		*10 tons dung.*		*Artificials only.*		*Artificials + 10 tons dung.*	
tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
9	12	12	18	12	15	12	18

The addition of artificials to the dung gave no increase in yield.

The case is different when the climatic conditions allow of larger crops. In the north of England yields are considerably heavier than at Rothamsted, running to 25 tons per acre or more, and Professor Gilchrist finds that under ordinary circumstances they justify the addition of 4 cwt. basic slag or 3 cwt. superphosphate, as well as 1 cwt. sulphate of ammonia to the 12 tons of good dung per acre.

It is usually safe in manuring to aim at as large a crop as the climate will allow, but also to recognise that fertilisers must not be expected to overcome the effects of the weather.

Muriates or Sulphates as Manure.—Farmers are now offered the choice of muriate or sulphate of potash, and it is possible that they may at a future date be able to obtain muriate of ammonia. Experiments are being carried out at Rothamsted and elsewhere to ascertain the manurial value of these newer substances. Before the War the problem never arose: all the available potash salts came from one source and it was no advantage to the farmer to obtain muriate rather than sulphate. Nowadays, however, there is more than one source of supply, and the possibility of competition accordingly exists. It is therefore imperative that the relative values of the two substances should be carefully and impartially tested. This is being done, but as everyone familiar with agricultural experiments will realise, the tests must go on over several seasons before anything very definite emerges.

There already exists, however, a certain amount of information which may easily prejudice the matter because it is not strictly

applicable to farming practice. In laboratory experiments muriates have sometimes done a certain amount of harm to growing plants. These experiments, however, were not carried out in soils, but under the rather artificial conditions of water or sand cultures, and while the results are of scientific interest, they cannot be directly applied to field conditions. Soil has a great capacity for counteracting harmful effects, and it may easily happen that a substance which is somewhat injurious in the physiological experiment behaves quite differently in the field. It is necessary, therefore, to approach the subject of fertiliser value with a perfectly open mind.

Since only one season's results are available it is not possible to discuss them in any detail, but some interesting points stand out. In the case of both muriate of ammonia and muriate of potash no signs of harmful effects corresponding with the purely laboratory experiments were seen so far as the writer is aware, but there were cases when the yield from the muriate was less than the yield from the sulphate, although there were also cases where no difference was observed between them.

The results seem to suggest that under some conditions farmers could use either the muriate or the sulphate, whichever they pleased, with a reasonable expectation of obtaining the same return; but under other conditions the sulphate would be safer. It is hoped that the experiments will be continued long enough to allow us to say just what are the conditions in which the two manures act alike, and under what conditions preference should be given to the sulphate. The writer would appreciate any records from farmers who have had experience with both types of fertilisers.

Effect of the Manuring of Grassland on the Yield of Milk.—An experiment made more than ten years ago at the Midland Agricultural College, and afterwards repeated at the Harper Adams Agricultural College, deserves to be brought again to the notice of dairy farmers, and might well be repeated as a demonstration at other centres. Part of a pasture field was dressed with fertiliser and part left unmanured: the plots were completely fenced in and cows were grazed on them. At the Midland Agricultural College the experiment was begun by Mr. J. F. Blackshaw and continued for three years, records being kept of the quantity and, over a considerable period, of the composition of the milk. The fertiliser used was a single dressing of 4 cwt. superphosphate and $1\frac{1}{2}$ cwt. sulphate of potash per acre. The results when worked out as gallons of milk per acre are as follows:—

	Yield on unmanured plot. gal. per acre.	*Yield on manured plot.* gal. per acre.	*Increased yield due to manure.* gal. per acre.
1st year ...	136	220	84
2nd year ...	164	250	86
3rd year ...	137	218	81

In the fourth year the increased yield was 119 gal. per acre. Even at the pre-war price of milk (6d. per gal.) the whole cost of the manure was paid off in the first year, and there was a balance on the farmers' side, while the whole of the increased yields in the 2nd and 3rd years were clear profit.

Analyses of the milk by Mr. Golding showed, as the result of manuring, a large increase in the total amount of butter fat, but a slight falling off in the percentage, and no appreciable change in the percentage of other constituents of the milk, though of course an increase in the total amounts.

The Harper Adams experiments were on slightly different lines, there being three plots—one unmanured, one receiving superphosphate only (2½ cwt. per acre), and the third receiving superphosphate (2½ cwt. per acre) and potash (½ cwt. sulphate of potash per acre). The average yields of milk for the three years summer grazing (20 weeks) were :—

Yield on unmanured plot. gal. per acre.	*Yield from superphosphate only.* gal. per acre.	*Yield from superphosphate. + potash.* gal. per acre.
175	208	212

Again a distinctly profitable increase from the use of fertilisers.*

Use of Lime on Corn Crops in which Clover is to be Sown.— A correspondent raises the question whether lime should be applied to a corn crop in which clover is to be sown, when there is reason to expect a deficiency of lime in the soil. This should certainly be done. Cases are constantly being brought to the writer's notice of failure of clover, either in patches or over a large part of the field, owing to shortage of lime. Typical instances are as follows :—

	Herts.	*Suffolk.*	*Norfolk.*
On the good parts ...	0·2	0·8	0·6 per cent. of calcium carbonate
On the bad patches ...	0·01	0·07	0·2 „ „ „ „

The correspondent further asks whether hydrate of lime would be a suitable substance for the purpose. It would. He should, however, obtain quotations for ground limestone, which would also be suitable: it is too late now for quicklime. In comparing prices it should be remembered that 100 lb. of ground limestone has the same effect as 74 lb. of hydrate of lime, and therefore it should be correspondingly cheaper.

* The results of these experiments are also discussed together with those obtained in experiments in Ireland in *Miscellaneous Publication* No. 30, pp. 6, 7, 8, 19, 20, 21.

Official Seed Testing Station.

WITH the passing of the Seeds Act, 1920, the direct control of the Official Seed Testing Station was delegated by the Ministry to the Council of the National Institute of Agricultural Botany, Cambridge. The Annual Report of the Official Seed Testing Station for the season 1920-21 is being published by the Institute and will shortly be obtainable at a nominal charge on application to the Secretary of the Institute, Huntingdon Road, Cambridge.

The following notes summarise the results of the past season's work, and indicate the nature of the subjects dealt with in the Report.

(1) The number of samples tested during the season 1920-21 was 23,577, an increase of 3 per cent. on the previous season's total. This is exclusive of about 1,500 samples of packet seeds tested on behalf of the Seed Control Branch of the Ministry.

(2) The number of farmers' samples received is still very low, only 750 farmers having sent seed for test. In any county the number of farmers utilising the Station appears to be in direct proportion to the activity in this direction of the County Organiser.

(3) The quality of seeds tested was on the whole good. In most cases the germination average is lower than that of the previous season, but this was mainly due to the indifferent harvest conditions in 1920. There was a most marked improvement, however, in the purity of clover and grass samples. With the exception of meadow fescue, all clovers and grasses showed increased purity figures. The following table shows the average yearly figures for all clovers and grasses scheduled in the Testing of Seeds Order:—

	Clovers.		*Grasses.*	
	Percentage Purity.	Percentage Germination.	Percentage Purity.	Percentage Germination.
1917-18	95·9	68·8	97·3	74·2
1918-19	95·7	78·8	97 8	82·1
1919-20	95·5	82·5	98·0	83·5
1920-21	96·6	80·6	98·1	81·9

(4) Great trouble was again experienced with delayed germinations of cereals due to incomplete after-ripening. It may be added that the favourable harvest weather of 1921 has to a great extent prevented a repetition of this difficulty during the current season.

(5) The improvement in the figures for the dodder content of clovers reported last season is maintained. Nevertheless,

nearly 20 per cent. of the samples of red clover received at the Station contained seeds of this parasite. About 4 per cent. of English red clovers contained dodder, and it is worthy of note that the large seeded form occurred almost as frequently as the small seeded "English" dodder.

(6) All varieties of clover of Czecho-Slovak origin continue to show high percentages of weed seeds and dodder.

(7) A large number of tests were made on species not scheduled in the Testing of Seeds Order, and it is satisfactory to note that such seed was found to be of good quality.

(8) Opportunity might here be taken to draw attention to two modifications in Seed Testing practice brought about by the passing of the Seeds Act.

(*a*) Since 1st August, 1921, the Continental method of testing grass seed has replaced the Irish method. The general tendency of this change is to reduce the average purity figure and to increase the average germination. This difference must be borne in mind when comparing the results of tests made since 1st August with those of tests made previous to that date.

(*b*) The germination of mangolds and beet is now estimated in terms of "germinating clusters," and not, as hitherto, in terms of "sprouts." In view of this, the "minimum percentages of germination" for these species have been reduced from 120 per cent. and 90 per cent. to 60 per cent. and 50 per cent. respectively.

* * * * * *

The Annual Report of the Chief Veterinary Officer for 1920.

THIS Report, being the first Report with regard to diseases of animals since the Animals Division of the Ministry was reorganised at the end of 1919, has now been issued over the signature of Sir Stewart Stockman, the Chief Veterinary Officer. It contains particulars of the various outbreaks of foot-and-mouth disease, swine fever, anthrax, parasitic mange, sheep scab, glanders and other diseases prevalent in farm animals, and the work of the Diseases of Animals Branch in connection with them. It also contains particulars of administrative action in regard to the exportation of horses, the importation of dogs, and the landing of animals from Ireland, as well as an account of the steps taken during the year 1920 in regard to importations under the Foreign Hay and Straw Orders, and the weighing of cattle under the Markets and Fairs (Weighing of Cattle) Acts, 1887 and 1891.

The Report also deals with such interesting topics as the outbreak of cattle plague in Belgium which took place in 1920,

the proceedings at the Ministry's Cattle Testing Station at Pirbright, where cattle intended for export are tested for tuberculosis, or immunised against red water prior to export to South America, East Africa, etc., and also gives an account of the work carried out at the Ministry's laboratory. Under the latter heading, no less than 4,052 specimens were examined for the purposes of diagnosis of scheduled diseases, and 235 others for non-scheduled diseases, and 913 litres of anti-swine-fever serum were prepared during the year, and 390 litres distributed for use in outbreaks during the same period. In regard to vaccination against epizootic bovine abortion, 24,520 lb. of vaccine were prepared and distributed for the inoculation of animals in affected herds.

The Report is published by H.M. Stationery Office, and is to be purchased through any bookseller, or direct from the Stationery Office, price 2s. 6d.

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Investigations into Silver Leaf Disease.

THE havoc wrought by Silver Leaf disease in plum growing districts is unfortunately only too well known to growers. The fungus has killed thousands of trees and has rendered it almost impossible for growers to cultivate Victoria and Czar plums in some districts. It is not too much to say that unless some adequate measures of control are adopted, the very existence of the plum growing industry in this country is threatened. The damage caused by the disease, however, is by no means confined to the plum. Mr. F. T. Brooks of Cambridge has recently reported that the fungus is now attacking apple trees, particularly Early Victoria, Lord Grosvenor, Lord Suffield and Newton Wonder. Mr. Brooks also states that he has found the disease on pear trees, which had hitherto been considered to be immune from attack.

For some years past, Mr. Brooks has been carrying out investigations into the disease, and more recently in conjunction with Mr. Hatton, the Director of the East Malling Research Station, has been undertaking experiments to determine the relative susceptibility of the common varieties of plum when worked on different stocks. It will necessarily be some few years before any definite results can be obtained from these experiments, but from observations made in orchards, it does appear that the stock is capable of influencing the tree to a marked degree. One case which came under observation in a Huntingdonshire orchard is particularly convincing. This orchard is

fully planted with Victorias, of which the majority are worked in the usual way on the Myrobalan stock; these are considerably infected. The remaining trees have been worked on another stock (probably the common plum), in such a way that most of the trunk of the tree belongs to the stock. The habit of growth of these trees appears to have changed very considerably, and apparently they are highly resistant. Further inoculation experiments made by Mr. Brooks have shown, that while the Pershore variety can be readily infected with the disease, there is a high percentage of natural recovery. The results of these experiments are very encouraging.

Mr. Brooks sounds a note of warning with regard to the propagation of plum trees. He has noticed cases in which silvered suckers have been used for propagation, and as he rightly points out, trees raised from diseased suckers are doomed from the commencement.

As regards methods of control, Mr. Brooks is convinced that the adoption of a proper system of plant sanitation, the importance of which cannot be over-estimated, is undoubtedly effective. Infected wood and all dead wood must be cut out and burned without delay, and the wounds thereby made must be protected immediately by a covering of grafting wax, tar, or similar material. Apart from the removal of diseased and dead wood, the less plum trees are cut about the better. It does not suffice, however, merely to burn the infected material cut from the fruit trees. Careful attention must also be devoted to those non-fruiting trees in the vicinity of plum plantations on which the fructifications of the fungus are commonly found. It should be remembered that Poplar trees, which are often planted as a wind screen, are susceptible to Silver Leaf disease when cut back, and that their dead stumps often constitute centres of infection.

All growers of fruit trees are strongly recommended to take action on the lines indicated above.

Immunity Trials of Potatoes, 1921.

THE Potato Immunity Trials were continued in 1921 at the Potato Testing Station of the National Institute of Agricultural Botany at Ormskirk, Lancashire. The tests were carried out by Mr. H. Bryan, B.Sc., Superintendent of the Station, on lines laid down by the Ministry.

The season generally was peculiar because of the continued drought and the excessive heat, and

it soon became apparent that the varieties of potatoes would behave in a most abnormal manner. Varieties usually producing kidney-shaped potatoes tended to give ovals instead, while the oval varieties tended to yield rounds; the plants produced much secondary growth of the haulms; the first-formed tubers, even when quite small, sent out sprouts of considerable length. All the peculiarities due to the abnormal conditions had to be sifted out by Mr. Bryan before any true characteristics of the varieties could be determined and recorded, and for this work great ingenuity and patience were required on the part of the recorder. The main object of the trials was to provide a test from the results of which the Ministry would be able to decide as to the further varieties to be added to the list of Approved Immune Varieties for the purpose of the Wart Disease of Potatoes Order of 1919. It will be remembered that varieties are not added to the list until the Ministry is satisfied that they have successfully undergone a thorough test conducted on scientific lines. Generally one year's test must be considered insufficient for the results to be interpreted with accuracy; and decisions are given after the varieties have successfully passed through two consecutive tests, provided the weather during these years is normal in character.

The trials in 1921 were affected by the abnormal weather conditions to such an extent that, save in the case of a few varieties, no dependable interpretation of the results could be made, and the tests for most varieties will therefore need to be repeated in 1922. The Ministry regrets the unavoidable inconvenience that this may cause to breeders and raisers; but experiments in past years have definitely shown that the intensity of the disease is largely influenced by the amount of rainfall, and as this was but 6 inches during the months of June, July, and August, one would not expect to find much disease on any of the susceptible varieties, so that its absence could not be taken as proof of immunity.

The arrangement of the trials adopted in previous years was slightly modified, the different sections of the trials being arranged in proper groups. In the Immunity Trials there were 782 plots, of which 96 were being tested for the second time and 686 were being tested for the first time. Amongst those being tested for the second time, wart disease appeared late in the season in 9 varieties (Restorator, Ben Venue, Ben Lawers, Godolphin, Geante Sans Pareille, Seedling B.5, Seedling B.6,

Purple Eye No. 5, Seedling 105), and these for the future will be regarded as susceptible varieties. No wart disease occurred on 41 kinds, but the Ministry was able to make a definite declaration of immunity in the case of the following five varieties only:—Dunvegan, Ranfurly Red, The Celt, Barley Bounty, and G.10. The first four are listed as Approved Immune Varieties and G.10 can be listed when properly named by the introducer. A number (21) of American varieties of potatoes were included in these trials, and also in the trials of the Scotch Board's Station. No disease was seen on any of these varieties, but as the majority will probably not be introduced to the British potato-growing industry, it is not proposed unduly to lengthen the immune variety list by adding all these names *en bloc*. Should, however, the sender wish to introduce any of these varieties the Ministry would be prepared to list any distinct varieties that have successfully passed the tests. It is interesting to note that varieties which have proved immune in America have also remained immune when tested in this country, a fact which shows that the immunity of potatoes from wart disease is not an unstable character.

There were tested for the second time a number of varieties whose immunity must still remain doubtful; of these Ben Lomond and Ben Arthur are typical examples.

Of the many (686) varieties included in the test for the first time, a number (138) definitely contracted Wart Disease late in the season. Many proved synonymous with existing varieties and are referred to in the Report of the Synonym Committee of the National Institute of Agricultural Botany for 1921, but the following distinct varieties may now be definitely classed as susceptible:—

King Victor.	Guardian.	Farmer.
Vitality.	Jupiter.	Rouge de Soissinaise.
Improved Regent.	Grigor's Seedling.	Reed Major.
Craigend Abundance.	Esbie Selection.	Cornicubia.
Scarlet Marvel.	Geante Bleue.	

Of the number that remained free from wart disease, a large percentage were distinct and new to the Station. As previously stated, the test last season was by no means severe, and it is probable that a number in this group will prove susceptible when the test is repeated under more normal conditions.

A few of the stocks sent in were so mixed that it was impossible to select the plants which represented the true variety; the growth of other stocks, generally English and

Welsh, or Australian seed, was so weak that no proper records could be obtained.

In addition to the Immunity Trials proper, the Ministry, in continuance of its past policy, again accepted small quantities of seedlings from breeders for testing to provide quick information as to the susceptible ones.

* * * * * *

Prosecutions under Foot-and-Mouth Disease Orders.—A case was heard at the Bromley Police Court on 9th January, arising out of the Order of the Minister of Agriculture prohibiting the movement of animals in a part of Kent on account of the recent outbreak of foot-and-mouth disease at Sevenoaks. Two bullocks and 11 sheep had been sent by railway from Islington Cattle Market to Beckenham Station, and thence to the premises of a Beckenham butcher, thus being moved by road in the prohibited area contrary to the Order.

The Kent County Council instituted proceedings against the owner of the animals, and also the two railway companies who accepted the animals for conveyance to a destination within the prohibited area. Convictions were obtained, and the owner was fined £10 and £2 2s. costs, and the railway companies £10 and £5 respectively with £2 2s. costs in each case.

Whenever a case of foot-and-mouth disease occurs, and an Order prohibiting the movement of animals is made, the Order is at once published, and all the railway companies and other persons directly concerned are notified in order to stop the movement of animals in the locality at the earliest possible moment. This is essential to prevent the risk of a widespread dissemination of the disease, and stockowners or other persons who break the regulations bear a grave responsibility in view of the disastrous results which might follow from their actions.

At Middlesboro Police Court on 10th February, two offenders were prosecuted for neglecting to deliver up movement licences for pigs and cattle, and were fined £5 and £10 respectively, with costs in each case. All movement licences granted under the Foot-and-Mouth Disease Orders are required to be delivered up to the local police after the movement is completed. Unless this is done the authorities would not be able to maintain proper check on the movements in a scheduled area.

Eradication of Rabies in Great Britain.—By an Order which was made by the Ministry on 30th January, the remaining muzzling and movement restrictions imposed in great Britain on account of rabies, viz., those in force in Hampshire and Wiltshire, were finally removed as from 6th February, no case of rabies having occurred in those areas, nor in any other part of Great Britain, since 7th June, 1921.

In view of the freedom of the whole country from rabies for a period of eight months, the Ministry has every reason to believe that the disease has been entirely eradicated. After 16 years of freedom from rabies in the United Kingdom, the disease was re-introduced at Plymouth in the summer of 1918

by an imported dog, which, owing to the abnormal conditions arising from the War, escaped the Quarantine Regulations. This case was directly responsible for 129 cases of rabies between Devon and Cornwall before the disease was finally eradicated from those counties in August, 1919. The risk of re-importing rabies was increased during the period of demobilisation following the armistice, when, in spite of Army, Navy and Air Force regulations forbidding importation by members of His Majesty's Forces except under quarantine conditions, dogs were undoubtedly landed illegally. Some of these were detected and the offender dealt with. To such cases must be attributed the invasions of rabies in South Wales in March, 1919, in the Metropolitan area in April, 1919, in North Essex in August, 1919, and in Wiltshire extending into Hampshire and Do[illegible]setshi[illegible]y, 1920.

Seventeen co[illegible]all in the South of England or South Wales—were affected by the disease during the period from 1918 to 1921 (inclusive). The total number of confirmed cases of rabies was 319, but the number of reported cases investigated by the Ministry was 908. The total number of persons known to have been bitten by affected or suspected dogs was 236; of this number, 87 were bitten by rabid dogs and 123 underwent Pasteur treatment, by arrangement with the Ministry of Health, in Paris, Plymouth or London. None of these cases were known to have developed hydrophobia.

The method adopted by the Ministry in dealing with the disease may be summarised as follows:—

(a) Notification of suspected cases by telegram to the Ministry. Diagnostic inquiry at the Ministry's laboratory by examination of the head and neck of suspected animals.

(b) Immediate local inquiry by inspectors of the Ministry and Local Authority into the history of affected dogs and all contacts; particulars of persons bitten being sent at once to the Ministry of Health for action.

(c) On confirmation of a case of rabies, an Order is immediately applied by the Ministry to an area of about 15 to 20 miles radius around the place where the affected dog was found, requiring the muzzling of all dogs in public places and prohibiting the movement of all dogs out of that area except by licence and under quarantine conditions.

The consistent pursuit of this policy of muzzling and movement restrictions, involves considerable work; 18,053 licences were issued authorising the movement of dogs under these regulations. There is no doubt, however, that the control exercised by the Ministry has been justified by its success.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Howell, J. Pryse.—An Agricultural Atlas of Wales. (23 pp.) Southampton: Ordnance Survey, 1921, 5s. net. [63(42); 55.912.]

Bledisloe, Lord.—Potatoes and Pigs with Milk as a Basis of Britain's Food Supply. With some Hints on the Production of each. [A paper read before the British Association at Edinburgh, September 12th, 1921.] (59 pp.) London: Hugh Rees, Ltd., 1921, 15s. [338.1(02); 63.512; 63.64(02).]

Agriculture, General and Miscellaneous—*Contd.*

Rothamsted Experimental Station.—Library Catalogue of Journals and Periodicals. (70 pp.) Harpenden, 1921, 2s. 6d. [01.]

Newcomb's Farmers' Complete Account Book. [15th Edition.] (135 pp.) London: Simkin, Marshall & Co., Ltd., 1921, 12s. 6d. net. [657.]

Storm, A. V., and *Davis, K. C.*—How to Teach Agriculture: A Book of Methods in this Subject. (434 pp., with 223 illustrations.) Philadelphia and London: J. B. Lippincott & Co., 1921. [371.]

Woods, K. S.—The Rural Industries Round Oxford. (180 pp.) Oxford: Clarendon Press, 1921, 7s. 6d. [63.193.]

Canada Department of Agriculture Experiment Farms.—Bulletin 97:—Researches in regard to Wheat, Flour and Bread. (56 pp.) Ottawa, 1921. [664.6.]

Strasburger, E.—Text Book of Botany. [5th English Edition, revised with the 14th German Edition by W. H. Lang.] (799 pp.) London: Macmillan Co., 1921, 31s. 6d. net. [58.(02).]

Thatcher, R. W.—The Chemistry of Plant Life. (268 pp.) [illegible] and London: McGraw Hill Book Co., 1921, 18s. net. [54(02); 58 [illegible]

Field Crops.

Kentucky Agricultural Experiment Station.—Bulletin 232:—Soybeans (57 pp.) Lexington, 1921 [63.321.]

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Horticulture and Fruit Growing.

Wright, W. P. (Edit.).—Practical Gardening for Profit and Pleasure (6 vols.) Vol. i:—Garden Practice and Plant Life. (367 pp.) vol. ii:—Vegetables and their Cultivation. (365 pp.); vol. iii:—Practical Fruit Growing. (367 pp.); vol. iv:—Glass Houses and Pot Plants. (359 pp.); vols. v and vi:—The Flower Garden. (360 and 376 pp.) London: The Educational Book Co., Ltd., 1921, £4 5s. net the set. [63.5(02).]

Fletcher, F. J.—Market Nursery Work. Vol. i:—Glasshouses and the Propagation of Plants. (73 pp.); vol. ii:—Special Glasshouse Crops. (70 pp.) London: Benn Bros., Ltd., 1921, 4s. 6d. net each volume. [63.5-19.]

Newsham, J. C.—Fruit Growing for Profit. (220 pp.) London: C. A. Pearson, Ltd., 1921, 6s. net. [63 41(02).]

Hooper, C. H.—Fruit Farming: Practical and Scientific for Commercial Fruit Growers and Others. [2nd Edition.] (203 pp.) London: The Lockwood Press, 1921, 6s. net. [63.41(02).]

Thomas, Owen.—How to Prune Roses and Fruit Trees. (32 pp.) London: Country Life Offices, 1921, 9d. net. [63.41-195; 63.52.]

Live Stock.

Elwes, H. J.—Guide to the Primitive Breeds of Sheep and their Crosses with Notes on the Management of Park Sheep in England and the possible advantages of Crossing them with Improved Breeds. (69 pp. and plates.) Edinburgh: R. R. Clark, Ltd., 1913, 2s. [63.602; 63.63(02).]

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Davies, R. E.—The Home Doctoring of Goats, Rabbits and Poultry: A concise, simple and alphabetical guide. (52 pp.) London: Benn Bros., Ltd., 1921, 2s. net. [619.3; 619.5; 619.9.]

Linton, R. G.—Veterinary Hygiene. (429 pp.) Edinburgh: W. Green & Son, Ltd., 1921, 26s. net. [619(02).]

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